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EPIPHYTES ON SOAP-NUT TREES IN SRIHARIKOTA, NELLORE DISTRICT.

Sriharikota is a small island situated in the south-east corner of the Gudur Taluk, in the Nellore District between the Pulicat Lake and the Bay of Bengal. It is about 25 miles long and its breadth varies from one to five miles. The soil of the place is sandy. It contains a natural forest, extending from north to south, which has been constituted a Reserved Forest, with an area of over 25,000 acres and which is called the "Sriharikota Reserve" after the name of the island.

The forest is very dense in the middle and in the north, it is moderately so in the west and sparse in the south. On the east, *i.e.*, on the seaside, the growth of the trees is thin and stunted, as the sea-breeze tends to stunting and as sandy dunes are formed by the drifting of sand. The strong eastern wind alters the shape of the tree from one of tapering to one of slanting towards the west. Practically for a furlong or two from the coast there is no tree-growth except that of isolated trees of Margosa (*Melia indica*) or Chikirein (*Albizzia amara*) whose mis-shapen

Photo.-Mechl. Dept., Thomason College, Roorkee.

EPIPHYTE ON THE SAPINDUS EMARGINATUS.

crown and prostrate form show the enormous power of the eastern wind.

Though this forest cannot boast of big timber-yielding trees, yet it consists of various species of trees and shrubs, yielding good fuel and minor produce. The chief minor products obtained in this forest are—(1) *Nux Vomica*, (2) Soap-nuts, (3) Tamarind, (4) Rattans, and several kinds of bark and roots. The annual revenue derived from the minor produce in this forest is about Rs. 7,000, principally from soap-nuts and *Nux Vomica*.

In the Sriharikota Reserve there are many soap-nut trees (*Sapindus emarginatus*), which annually yield about 150 candies of soap-nut. This soap-nut has a marketable value and fetches Rs. 10 a candy. It is on this tree that Epiphytes are found growing luxuriantly. Most of the trees have on them these Epiphytes, which affect their growth and the development of their leaf-canopy and consequently their yield capacity becomes much reduced.

DESCRIPTION.

The plant Epiphyte is found having a bushy growth over the bole of the soap-nut tree. The leaves of the plant are long and its stem is not thicker than the small finger. It has aerial roots in addition to the innumerable roots that penetrate the crevices of the bark and hold the tree very firmly. The stem, though thin, is too strong to be easily broken. This Epiphyte is said to be identical with the (Vanda), *Orchedesia* species. The flower is white fringed with a violet tint and has a pleasant mild fragrant smell. The pods are about 2 inches long and when ripe they fall, thus allowing the wind to carry the seed in all directions. The whole plant forms a lattice work of roots and stems, so much so, that it would be difficult to separate it from the host tree.

HABIT.

This Epiphyte is generally found not only on soap-nut trees but also on other trees such as Kotta, Juvoi (*Ficus tomentosa*) and other *Ficus* species. It is found to grow on the top of the

bole, where the tree branches off and to extend to the branches themselves. It is said that the Epiphyte generally finds its nourishment from the dust and *débris* found on the decayed portion of a tree. It is, however, observed that this Epiphyte thrives very well on a sound tree. The roots which spread over the tree do not penetrate even the bark and do not sap the host tree. The nourishment required is got from the atmosphere, through the aerial roots and the usual respiration seems to take place through the leaves. Thus the plant sustains itself without the aid of the tree on which it grows.

EFFECT.

This Epiphyte does not grow to such a height as to cover up the crown of the host tree and deprive it of the light and heat required for its development, nor do the roots of the Epiphyte reach the ground to compete with the host tree in taking up the underground nourishment required for its sustenance. Though the plant does not live at the expense of the host tree, yet the strong grip of the plant has the effect of strangulation. The roots form a net-work at the stems and branches of the trees and hold to the trees so firmly that the circulation of sap from the leaves to the roots through the cambium is prevented. The portion of the branch above the grip of this Epiphyte becomes languid, as sufficient quantity of nourishment cannot be got from the roots and as the elaborated sap cannot be circulated by the leaves to feed the root and the stem. Owing to cessation of circulation of sap, leaves wither away, branches die off, and finally it results in the death of the tree itself. The effect of the strangulation of the Epiphyte can be seen in the stag-headed crown of the tree in Plate I.

Most of the trees in the Sriharikota Reserve are stag-headed, having little or meagre foliage. This is due to the Epiphyte growing on them. When the leaf-canopy is defective, the yield is likewise defective. Thus the tree that should have given an abundant crop, yields a comparatively small one and the annual outturn is thus considerably diminished.

REMEDY.

The remedy laid down is judicious pruning of the branches, etc., affected. But the existing state of the trees in the forest does not allow the remedy to be applied. So the plant finds its place at the top of the bole and extends to the branches, it has been in practice found difficult to prune off the branches, unless they were cut on the bole of the tree. This would damage all the trees affected by the Epiphyte, rather than improve them. So another method has been adopted. The sole cause for the damage of the trees is the grip of the plant, and as the roots do not penetrate beyond the bark, it has been tried to remove the plant by scraping off the roots with a sharp knife without damaging the cambium layer of the tree. This has had the desired effect When the trees are cleared of the pest, the condition of the trees is improved. When the trees are freed from the grip of the Epiphyte they begin to regain their vigour and put forth fresh and abundant leaves. An area of 455 acres was thus treated in December 1910 and during the succeeding vegetative season, all the trees that were previously bare have put out leaves and their crowns have mproved. With the improvement of crowns, there is no doubt that the yield will also increase.

The cost for the clearing of the Epiphytes over an area of 455 acres is only Rs. 14. On an average the expenditure is only 6 pies per acre. At a small expense vast improvement could be made in the condition of the affected soap-nut trees. This will not only improve the stock of the forest but will also go to enhance the revenue by making it yield a better and more paying crop.

I tried several experiments by attaching branches of Epiphytes to several trees, such as Tamarind, Chikirein, Kotta, Margosa, *Nux Vomica*, Drum-stick, *Casuarina* and Palmyra. These were tied with a string to a branch to prevent them from falling to the ground. About three months after, I found them growing vigorously on almost every tree, even including the Palmyra. They have thrown out several aerial roots, some dangling in the air and some spreading and taking strong hold in the crevices of the bark of the trees and thus establishing themselves on the trees. They have

also put out several new branches. These seem to grow on any *living tree, provided they* have the required light and heat, as the following will show.

Two branches of soap-nut trees containing the Epiphytes were taken. One of them was thrown on the ground in the open air and the other was hung inside a hut thatched and walled round with palmyra leaves. It had an open passage of 5 feet high and 2½ feet broad. After three months, I found the plant inside the hut *was dead, but the one in the open air was healthy and flowering.* Though the Epiphyte gets its nourishment from the atmosphere, light and heat are essential for its growth and development.

The Epiphyte is injurious to the forest growth, as it will in course of time kill the tree on which it grows and spread itself to the whole forest by the distribution of seed, which is carried in all directions by the wind. But it may, for ornamental purposes, be *grown in* a *flower garden,* on account *of its bushy* growth and fragrant smell given out by the flower.

MADRAS: (Sd.) C. BALAYYA NAYUDU,
26th September 1912. *Forest Ranger.*

MEMORANDUM ON THE TEA-CHEST INDUSTRY IN TRAVANCORE.

Introductory.

The *Cochin Argus* of the 1st July 1911 contained a short paragraph regarding the Tea-Chest Industry, and in the opinion of the writer, it was considered desirable to undertake an investigation with a view to ascertain whether " Poolah " wood (*Bombax malabaricum*), which is the wood generally used in these parts for tea-chests, cannot be had in abundance and at sufficiently cheap rates, and also whether our forests do not contain cheap timbers other than " Poolah" which could be used for Tea-chests and packing cases. Government having thereupon called for a *full* report on the subject, the following facts and figures have been gathered in the course of an enquiry made into the matter.

2. The Tea-Chest Industry seems to have been started in Travancore about a quarter of a century ago, Messrs. Cameron, Chisholm & Co., who were the pioneers of the industry in Travancore having been engaged in the business since 1887 or so. Messrs. Aspinwall & Co., of Cochin, who are large manufacturers of tea-chests, started business in this line in 1892. Roughly speaking, therefore, the industry has been in existence in Cochin and Travancore for the last twenty to twenty-five years.

Past history.

3. From the communications received from leading Firms in Travancore and Cochin, it is gathered that "Elavu" (*Bombax malabaricum*) or "Poolah," as it is otherwise called, has been invariably used for the purpose. Other species, such as "Cheeni" (*Tetrameles nudiflora*), "Pala" (*Alstonia scholaris*), "Venkotta" (*Lophopetalum Wightianum*), and "Mango" (*Mangifera indica*) have also been used in Travancore, though the Cochin Firms say they use "Elavu" exclusively and "Cheeni" only in small quantities.

Kinds of species used.

4. The two Firms in Quilon, *viz.*, Messrs. Cameron & Co., and Messrs. Chisholm, Ewart & Co., have not furnished figures to show the average quantity of these soft woods which they have approximately consumed during the past so many years, but Messrs. Aspinwall & Co., of Cochin, state that their annual consumption has averaged 13,576 candies or 212,125 cubic feet for the last 19 years. They say that their present annual requirements will amount to 20,000 candies or 312,500 cubic feet. Taking into consideration the agreements which have been entered into with Messrs. Chisholm, Ewart & Co., and Cameron & Co., for the supply of cotton-wood and other soft woods, it can, I think, be safely put down that they have on an average consumed about 5,000 candies per year for the last twenty or twenty-five years. Roughly speaking, then, the average consumption of timber for tea-chests would have been very nearly 20,000 candies by the aforesaid three Firms. With a view to ascertain the quantity of soft woods sold by the Department during the past years, the Divisional Forest Officers were

Quantity consumed.

addressed, and it has been found that from the Northern Kottayam, Central and Quilon Divisions (there being no sales from the High Range and Southern Divisions), the quantity of "Elavu" sold has been on an average of 171,144 cubic feet per year for the last five to nine years. These figures cannot, however, be taken as representing the total quantity consumed, because large quantities must have been felled and removed from private lands, estates, etc. It is also seen that other species, such as "Cheeni," "Venkotta," "Pala," "Ooravoo" (*Machilus macrantha*) and other species were removed from the forests by consumers or purchasers, but whether they were utilised for the manufacture of tea-chests or for other purpose by the consumers it is not possible to say. It has not been possible to obtain reliable figures either as to the total quantities and different species consumed in previous years for this industry or as to the cost of their exploitation and the prices realised for the timbers so utilised.

Future possibilities of the Industry and its expansion.

5. That the Tea-Chest Industry is capable of considerable expansion in the future is a fact that admits of no doubt, as the present demand is expected to double in the course of a few years. Already in several parts of India, the cultivation of Tea in large tracts has been taken in hand and evidences are not wanting to show that its cultivation is largely expanding, in spite of the fact that rubber has been absorbing the attention of planters during recent years. But in order that the Tea-Chest Industry in Travancore may continue without hindrance, it is necessary that local firms manufacturing the chests should obtain the raw material in sufficient quantities and at sufficiently low rates to enable them to compete with the boxes imported from foreign countries. Messrs. Cameron & Co. have stated that Japanese and Norwegian competition is so keen that the timbers employed locally for the purpose of manufacturing tea-cases should always be priced low so that such timbers may be utilised to advantage, and Messrs. Aspinwall & Co. have hinted that at present planters show a tendency to make use of "patent" packages owing to the recent advance in prices of the locally

made chest consequent upon increase in cost of the raw material. If then the raw materials required for the manufacture of tea-chests can be supplied to consumers at cheap rates, there is no doubt that the industry will improve vastly in the near future.

Availability of soft-woods in our forests and their suitability for tea-chests and packing cases.

6. So far as the question of the availability of soft woods in our forests is concerned, there can be no doubt that we have many species of soft-wooded trees which are well suited for tea-chests and packing cases. In Troup's "Indian Woods and their Uses" (page 39) and in the *Indian Forester* for March 1908 (page 172) are given lists of woods suitable for tea-boxes, and from a perusal of the same it is seen that no less than 21 of the species therein mentioned occur in Travancore. Their names and weight per cubic foot are as follows :—

					lbs.
1.	*Acrocarpus froxinifolius*	...	Kurangau	...	39
2.	*Albizza odoratissima*	...	Pulivāgai	...	50
3.	„ *procera*	...	Karinthagara	...	45
4.	„ *stipulata*	...	Pilivāgai	...	29
5.	*Alstonia scholaris*	...	Pālai	...	27
6.	*Anthocephalus Cadamba*	...	Attuték	...	40
7.	*Bombax malabaricum*	...	Elavu	...	29
8.	*Cedrela Toona*	...	Mathagirivembu	...	35
9.	*Cordia Myxa*	...	Virasu	...	33
10.	*Erythrina indica*	...	Mullumurukku	...	...
11.	*Amoora Rohituka*	...	...	...	41
12.	*Ficus glomerata*	...	Atthi	...	30
13.	*Gmelina arborea*	...	Kumbil	...	35
14.	*Mangifera indica*	...	Mavu	...	42
15.	*Sterculia villosa*	...	Vakka	...	18
16.	„ *alata*	...	Anathondy	...	41
17.	*Stereospermum chelonoides*	...	Pombathiri	...	42
18.	*Tetrameles nudiflora*	...	Cheeni	...	24
19.	*Vateria indica*	...	Payin	...	39
20.	*Dipterocarpus indicus*	...	Vellaini	...	47

To these, the following species not mentioned in the lists above referred to, but whose suitability for tea-chests and packing cases has been admitted on other authority, should be added, *viz* :—

			lbs.
21.	*Ficus religiosa* ...	Arasu ...	35
22.	*Melia dubia* ...	Mala-vembu ...	26
23.	*Lophopetalum Wightianum*...	Venkotta ...	30
24.	*Machilus macrantha* ...	Uravu ...	36
25.	*Hardwickia pinnata* ...	Kodapalai ...	46

From Troup's book, "Indian Woods and their Uses," it is seen that the timbers used for packing cases should be light, capable of being easily worked and sufficiently soft to admit of nails being easily driven into. In addition to these qualities, the timbers should be free from shrinking, warping and splitting, and from injurious coloring matter. Timber used for tea-chests should, besides possessing the above qualities, be free from any liability to corrode the lead-lining of the boxes and should not be possessed of any powerful odour.

Untried soft woods awaiting testing of their suitability.

7. Four ("Elavu," "Cheeni," "Pala" and "Mango") of the species enumerated above have already been tested and have been found suitable for the purpose, especially "Elavu." Many of the species occur commonly in Travancore, though sparsely distributed but some of them are rather heavy and may not on that score commend themselves for tea-chests. There are lots of other soft woods which have never been tried for tea-chests and which may be found suitable for the purpose. The following are a few such species available in our evergreen forests at low elevations whose suitability may be tested :—

			lbs.
1.	*Polyalthia fragrans* ...	Nedunar ...	41
2.	*Xylopia parvifolia* ...	Santhu ...	44
3.	*Cratæva religiosa* ...	Nir-mathalom ...	28
4.	*Sterculia urens* ...	Thondi ...	42
5.	" *guttata* ...	Kithondi ...	22

			lbs.
6.	*Sterculia colorata*	Malamparathi	24
7.	*Grewia lævigata*	„	36
8.	*Elæocarpus serratus*	Nallakara	33
9.	„ *oblongus*	Kattakara	...
10.	„ *tuberculatus*	Ruthrachom	33
11.	*Evodia Roxburghiana*	Kanalei	27
12.	*Ailanthus malabarica*	Mattipal	23
13.	*Canarium strictum*	Thelli	35
14.	*Anacolosa densiflora*	Kalpottan	46
15.	*Turpinia nepalensis*	Kanali	28
16.	*Meliosma Wightii*	„	31
17.	*Buchanania latifolia*	Morala	36
18.	„ *lanceolata*	Malamavu	...
19.	*Odina Wodier*	Kalasau	60
20.	*Spondias mangifera*	Ambalam	22
21.	*Erythrina stricta*	Murukku	16
22.	*Poinciana regia*	„	28
23.	*Pithecolobium Saman*	„	31
24.	*Blepharistemma corymbosum*	Nir kurunda	42
25.	*Terminalia belerica*	Thanni	42
26.	*Barringtonia racemosa*	Samuttram	28
27.	*Sonneratia acida*	Thirala	36
28.	*Mastixia pentandra*	Velladambu	28
29.	*Sarcocephalus Missionis*	Attuvanji	37
30.	*Anthocephalus Cadamba*	Attuthéku	40
31.	*Stephegyne parvifolia*	Nirkadambu	39
32.	*Hymenodictyon excelsum*	Ittilei	28
33.	*Chrysophyllum Roxburghii*	Atha	36
34.	*Symplocos macrocarpa*	Paralei	31
35.	„ *spicata*	Kamblivetti	37
36.	*Wrightia tomentosa*	Mailam Pala	34
37.	*Ehretia lævis*	Chavandi	33
38.	*Myristica magnifica*	Kothapaun	30
39.	„ *Beddomei*	Kattu Jathika	34
40.	„ *malabarica*	Ponnampainu	34

				lbs.
41.	*Myristica canarica*	...	Undeipainu	... 34
42.	„ *attenuata*	...	Chorapainu	... 35
43.	*Cinnamomum zeylanicum*	...	Karuva	... 36
44.	*Aporosa Lindleyana*	...	Vittil	... 38
45.	*Mallotus albus*	...	Vatta kumbil	... 31
46.	*Excœcaria Agallocha*	...	Komati	... 25
47.	*Trewia nudiflora*	...	Malam kumbil	... 29
48.	*Macranga Roxburghii*	...	Vattakanni	... 27
49.	*Ficus gibbosa*	...	Ithi	... 42
50.	„ *bengalensis*	...	Peral	... 36
51.	„ *tomentosa*	...	„	... 41
52.	„ *retusa*	...	Kal-athi	... 37
53.	„ *nervosa*	...	Nir-al	... 35
54.	„ *Tjakela*	...	Kar-al	... 30
55.	„ *Tsiela*	...	„	... 34
56.	„ *infectoria*	...	Cherla	... 34
57.	*Antiaris toxicaria*	...	Maraüri	... 24

Probable supplies that can be made in future, etc.

8. From the reports received from the Divisional Forest Officers on the subject, it is seen that in the Northern Division the forests are expected to yield on an average about 5,000 candies of cotton wood yearly for the next twenty-five years or so and from the Kottayam Division about 2,000 candies of cotton wood and other soft woods can be worked down for the next ten or twelve years. The Divisional Forest Officers are of opinion that the cost of extraction would average between Rs. 4 and Rs. 4-8-0 and that the selling rate should be fixed at Rs. 6 per candy ($15\frac{5}{8}$ c.ft.). The Central Divisional Forest Officer also says that soft woods sufficient to meet the demand for fifteen or twenty years are available, but is doubtful of the possibility of working them to the depôt at a profit. The Quilon Divisional Forest Officer says that present requirements can be met only from interior forests and that cost of exploitation would therefore be so heavy as to leave little or no profit to Government. Taking the State forests as a whole, I am inclined to believe that the existing

stock of softwoods would meet the requirements of the local firms engaged in the Tea-Chest Industry for the next fifteen to twenty years and that the cost of extraction would average about Rs. 5 per candy or a little more. The stock can be sold to consumers at lower rates than now Rs. 5-8-0 or Rs. 6 per candy. In the matter of the disposal of the softwoods of our forests, the question of large profits should be rather a secondary consideration subordinated to the disposal of the product and the support of an Industry that is bound to expand in the future and be the means of utilizing many of the less valuable species of softwoods common in Travancore. The removal of these softwoods would admit of the restocking of the areas with more valuable species. The continuance of the Tea-Chest Industry would popularise many of our timbers which still remain unknown to trade or industry.

Artificial plantations for the propagation of soft-wooded species.

9. *The question as to the advisability or otherwise of creating* artificial plantations for the raising of soft-wooded species is one that naturally enters into the discussion of a matter like this and with this view in mind the Divisional Forest Officers were called upon to give their opinion on the subject.

The Northern Divisional Forest Officer is not in favor of forming plantations of this kind, but suggests that as cotton wood is a fast grower and easy of propagation, experiments in broad-cast sowings in hillmen's clearings and other open places may be tried. The Kottayam Divisional Forest Officer is also of the same opinion. The Central Divisional Forest Officer thinks that owing to the greater demand for the raw material that may spring up in the near future, it would be well to start artificial plantations of softwoods. He estimates the cost to range between Rs. 20 and 25 per acre for the first year and an average of Rs. 10 for the next ten or fifteen years. The Quilon Divisional Forest Officer estimates the cost for such plantations at Rs. 32 for the first year and Rs. 12, Rs. 9 and 3 for the second, third and fourth to fortieth year of planting. The average cost of the formation of an acre of such a plantation therefore comes to Rs. 150 more or less according to the figures furnished by these officers. Both the Divisional

Forest Officers have evidently been under the mistaken impression that "Elavu" and other softwood plantations require the same intensive methods, attention, care, and outlay as Teak plantations; as a matter of fact this is not so. After clearing the sites, seeds of softwood species need only be sown broad-cast or dibbled in at certain distances apart and the after-treatment should be restricted to freeing the seedlings whenever required, till the seedlings overtop the surrounding rank growth. Being very fast growers, softwood seedlings will get ahead of their neighbours in three or four years. I should think that a total outlay of about Rs. 40 per acre is quite ample from start to finish of a softwood plantation. Mr. Troup of the Indian Forest Department estimates the total cost at Rs. 15 to Rs. 20.

Considering that we have now enormous quantities of softwoods in our forests, sufficient to meet the requirements of Tea-Chest Industry, Match Factories and even Wood-pulp industry for at least twenty to twenty-five years to come, there seems no immediate necessity to trouble ourselves seriously with the question of starting artificial softwood plantations for a decade or more. Meanwhile there is no harm in endeavouring to try experiments in the artificial growth of softwoods on hillmen's clearings by paying them rewards for raising such plantations on their clearings over a definite area in each of the Forest Divisions.

Practical method of extraction of existing softwoods.

10. The question, however, that should claim our immediate attention is how to extract and place upon the market the large quantities of softwoods now existing in our forests, especially evergreen forests. There is no doubt that the consumers of these softwoods would utilise them only if the raw material is delivered to them at very cheap rates so that they may be enabled to carry on the business with reasonable profit. The stock of softwoods now existing being only found in the interior forests, the cost of extraction and transport to the Depôt will necessarily be high, and it may not pay the consumers to purchase them at our depôts at that cost plus a small margin of profit to Government. The only way to work out the softwoods profitably

is to establish saw-mills in the interior forests and send out therefrom sawn boards so that saleable materials only will be transported, wastage being left in the forest. The High Range Divisional Forest Officer reports that in his inspection of the Periyar Valley falling within his Division, he found that large quantities of cotton-wood, "Venkotta," etc., occur in an area lying between the two extensive planting districts of Peermade and Devicolam, and that if a saw-mill could be erected there for the purpose of supplying tea-chests to the planters in that neighbourhood who now get their boxes from Quilon and elsewhere, the financial results of the undertaking would be very promising. If a central place could be selected for the saw-mill site, the distance to either of these planting districts would not be more than 30 miles, and the Divisional Forest Officer reports that there are not only facilities for opening out roads but that some of the existing cart-roads can be utilised with slight repairs.

11. The opening of communications into the interior forests, the introduction of mechanical contrivances for the felling, sawing and transport of timbers from the remoter areas, the increase to the present staff in order that sufficient hands may be available for these works of improvement are matters which must receive adequate attention before we can take in hand the development of sources of Forest Revenue other than those with which we have up to the present been occupied.

12. To sum up:—

(1) There is at present a demand for softwoods for Tea-chests, etc.

(2) The demand is likely to vastly increase in the course of a few years.

(3) The present stock existing in the forests may be sufficient to meet the requirements of the industry for another twenty to twenty-five years.

(4) In order that the available softwoods may be utilised by consumers, the raw material should be supplied to them sufficiently cheap to compete with imports of tea-chests from foreign countries.

(5) The question of opening "Elavu" and other softwood plantations may lie over for the present owing to want of staff, etc., but experimental cultivation of small areas by means of hill tribes may be undertaken with a view to the collection of requisite data.

(6) The question of improving communications, introducing up-to-date machinery and appliances for felling, working, and transport of timber, etc., should be taken up early, and with it, the increase of the staff necessary in order to cope with the work.

(Sd.) M. RAMA RAO,
Conservator of Forests,
Travancore State.

DATED QUILON :
22nd June 1912.

FOREST EDUCATION IN MADRAS.

Six and thirty years ago, Sir Richard Temple, then Lieutenant-Governor of Bengal, in one of his communications to the Government of India, advocated the establishment of a small provincial school in Bengal to train Forest Rangers and suggested that a few of the most promising of the locally trained men might, with advantage, be sent to Dehra Dun where it was proposed to have a central school for training forest subordinates for all the provinces.

The Lieutenant-Governor of Punjab in his communication to the Government of India, dated the 11th May 1877, went one step further and suggested that each province might have its own Forest School for training Rangers.

The late Sir D. Brandis, with his prophetic vision into the future, foresaw the formation of Provincial Forest Schools in different provinces of India (*vide* sub-para. 2, para. 31 of his Memorandum, dated the 1st September 1877).

Decentralisation was the central idea and basic principle of all the proposals indicated above, and it was in evidence even as early as 1876-77.

Is it a wonder, then, that decentralisation is the order of the day?

The recent opening of the Madras Forest College at Coimbatore is a bold step in the right direction. This College is for Southern India what the Imperial Forest College at Dehra Dun is for Northern India. Students from Madras, Bombay, Hyderabad, Mysore, Travancore and Cochin will, in future, be trained at the Madras Forest College as Rangers, and exceptionally good men selected as a rule from among the students of this College may be sent to Dehra Dun for a further course of training in Scientific Forestry as probationers for the Provincial Forest Service.

Grateful as we are for the opening of this College we cannot help expressing our surprise at the long period of incubation that it has undergone. Several years ago, it was given out that Madras was going to have its own school for training Rangers, and we dare say other provinces had, likewise, cherished similar pious hopes. It was Burma, the youngest but the most progressive of provinces, that, true to its own traditions, set a very good example to the other provinces by establishing a Forest School for training local men for Ranger's posts at Tharrawaddy (now at Pyinmana), and sent to Dehra Dun only men likely to get into the Provincial Forest Service.

In 1904, Madras woke up and did something less heroic but equally useful. It was the establishment of the training school at Coimbatore wherein Deputy Rangers and Foresters were trained. Lectures were all given in English.

The above school, during the four years it was in existence, did very good work and turned out excellent subordinates. The success of the school was so encouraging that it was considered necessary to have a permanent habitation for it. Accordingly, Mr. Lodge, the Conservator of Forests, Southern Circle, moved the Local Government to sanction the construction of a permanent building for the above school in the forest portion of the Collector's Office compound near the Gass Forest Museum.

Meanwhile, the Government of India raised the status of the Imperial Forest School at Dehra Dun to that of "Imperial Forest College" and added an institute for carrying out Forest

Research. Soon after, a third year's course was instituted for the training of probationers for the Provincial Forest Service. To this course were admitted specially selected men from among the Rangers of the various provinces. The natural sequence of this change of status and course of study at Dehra Dun was gradually to reduce the number of admissions to the Ranger's class and encourage admissions to the Provincial Service class. Each Local Government was duly apprised of the intentions of the Government of India regarding the future training of the Rangers at Dehra Dun and a broad hint was thrown out that each Local Government must make its own arrangements for training its Rangers and that Dehra Dun would, in future, train men only for higher appointments.

It was at this crisis that Mr. Lodge, Conservator of Forests, then Southern Circle, visited Dehra Dun in March 1907, as a member of the Board of Control, and saw for himself the congested condition of the classes and the increasingly pressing demand for admission from all Local Governments, Administrations and even Native States. It was then that he informed the writer of this note "before long, we have to undertake the training of our own Rangers and send in men to Dehra Dun only for the third year course."

Some time after his return to Madras, he heard that the Government of Madras had sanctioned the construction of a special building for the Forest School at Coimbatore and ordered the preparation of plans and estimates for an extension to the Gass Forest Museum.

In his current No. 1919, dated the 11th December 1907, Mr. Lodge asked the Board of Revenue for a consideration of certain suggestions, arrived at as the direct result of discussion and conference with Sir St. H. Eardley-Wilmot, late Inspector-General of Forests to the Government of India, who inspected some of the forests of Madras towards the close of 1907 and formulated certain proposals to the Government of Madras regarding the institution and development of Forest Research and Forest

education in the Presidency of Madras. Mr. Lodge's suggestions were :—

1. A Forest College for training Rangers must be opened in lieu of the Forest School then in existence, as the demand for trained Rangers was more urgent and as Dehra Dun could not take in enough men to meet the demand of all India.
2. The site chosen for the Forest School was neither adequate nor suitable for the purposes of a Forest College and a better and more extensive site could be selected in the neighbourhood of the Madras Agricultural College and Research Institute.
3. Forestry and Agriculture being closely related in many ways, Forest and Agricultural Colleges if located together could, with advantage, be made interdependent and mutually beneficial.
4. Coimbatore was an ideal place for a College of Tropical Forestry on account of its splendid climate and proximity to various kinds of forests worked under different systems of management; and
5. Coimbatore was likely to attract a larger number of students and be more popular than Dehra Dun on account of the distance, climate, language difficulty and the difference in the nature of forests and their method of treatment.

The Hon'ble Mr. Weir, having had the advantage of discussing the above fully with Sir St. H. E. Wilmot, was convinced of the necessity of having a separate Forest College for this Presidency and of locating it near the Agricultural College; thus he supported the proposals of Sir St. H. E. Wilmot and Mr. Lodge, and recommended them for the acceptance of Government. But the Government were not convinced of the necessity of making any provision for Forest Research work in the Forest College buildings at Coimbatore and ruled that the purpose of the Coimbatore College must be mainly educational. Meanwhile the Government

of India were requested to sanction the establishment of the College and provide the staff.

This was in June 1908 and the scheme then hibernated. Beyond a sort of academic discussion regarding the merits and demerits of Saidapet and Coimbatore, the two rivals for the honour of having the Forest College in its vicinity, there was no evidence of outside activity. For obvious reasons, (fully detailed in Mr. Lodge's note quoted above), Coimbatore was given the preference. Then the important question of the staff and its adequacy came to the front. Several references were made in the interval to the Government of India and some to the Secretary of State on this question. Meanwhile Bombay put forth a suggestion for the utilisation of the headquarter offices and buildings of Southern Mahratta Railway (now unoccupied), at Dharwar by the Forest College of South India. Madras had its own say in the matter and so had Bombay, I doubt not. Eventually it was decided by the Government of India that the Forest College for Southern India must be located at Coimbatore and opened at as early a date as possible.

In G. O. No. 3032-Rev., dated the 12th October 1911, the Government of Madras placed Mr. Lodge on special duty for one month to prepare a scheme for the early starting of the Forest classes and for the eventual constitution and control of the Forest College at Coimbatore.

On receipt of Mr. Lodge's report, dated the 13th November 1911, the Government of Madras in G. O. No. 788, dated the 16th March 1912, were pleased to order (1) that the College should be styled "The Madras Forest College," Coimbatore; (2) that the College should be opened on the 1st July 1912. Thus in accordance with the above orders of the Government, the Madras Forest College was opened on the morning of the 1st July 1912 with the first batch of 31 Madras students (all in Government employ) when Messrs. Cowley-Brown and Lodge, Principal of the Madras Forest College and Conservator of Forests, Western Circle, respectively, addressed the assembled students on their duties and responsibilities as Foresters. Incidentally, both of them dwelt on the

mportance of Forestry as a profession and the great part it is bound to play in the near future.

Superior staff consisting of :—

1. Mr. F. L. C. Cowley-Brown, Deputy Conservator of Forests, and Principal, Madras Forest College.

2. Mr. V. Subramania Iyer, Extra Deputy Conservator of Forests and Senior Instructor.

3. Mr. K. R. Venkatramana Iyer, Extra Assistant Conservator of Forests and 2nd Instructor.

Mr. C. Srinivasa Rao, Curator, Gass Forest Museum, Lecturer in Botany when the students are at head-quarters (Coimbatore).

Subordinate and Executive staff.

1. Sub-Assistant Surgeon.
2. Havildar.
3. Storekeeper.

Ministerial staff.

1. Head clerk.
2. Second clerk.
3. Typist.

Menials.

1. Four peons for the Principal.
2. Two peons for the Instructors.
3. One tent lascar.
4. One College peon.
5. One office watcher.
6. One masalchi.
7. One sweeper for the College.
8. Two malis for the arboretum.
9. One Hospital watchman.
10. Three sweepers for the Hostel.

At present, the College is located in the Old Municipal Hospital buildings temporarily taken up for the purpose, while the students board and lodge in the College and Y. M. C. A. hostels rented for the year. The new College buildings—of a graceful and imposing design—are being erected on a site of 167 acres about 2½

miles from Coimbatore. It is hoped that the permanent College and Museum buildings, Professors' and Instructors' quarters, hostels for the students and lodgings for the subordinates, clerical and menial staff in the extensive College site will all be available for occupation by July 1914. It is even likely that the Principal, students and menials will all find accommodation by 1st July 1913, in temporary sheds constructed, if necessary, for the purpose, lectures being given in the lecture tent.

The total cost of the buildings when completed will be in the neighbourhood of $7\frac{1}{2}$ lakhs. In the estimate, provision is made for the following buildings:—(1) Main building for the College; (2) Gass Forest Museum; (3) Quarters for the Principal, two Imperial Instructors and three Provincial Instructors; (4) Quarters for 60 students in six blocks, each block containing a separate dining-room, cook-room, store-room, bath-room and latrine; (5) Three lines of 10 quarters each for menials, and (6) Store godown for keeping tents, etc. There will, in addition, be an *arboretum* over a fourth of the area. It is also proposed to have a Hospital and Dispensary, a Post and Telegraph Office and an Elementary School common to both Agricultural and Forest Colleges on a triangular piece of land between the two sites.

Students.—Of the 31 admitted for the course of 1912—14

4	come from the	Western	Circle.
8	do.	Southern	do.
11	do.	Central	do.
and 8	do.	Northern	do.

Fifteen of them are already Rangers of the V and VI Grades, while the remaining 16 are Deputy Rangers of the II Grade. Their educational qualifications are somewhat varied.

	2	have passed in the First Art's Examination of the Madras University.	
	18	do.	Matriculation Examination of the Madras University.
	1	has do.	Entrance Examination of the Allahabad University.
	1	do.	High School.
and	9	have passed no examination.	

In the absence of a suitable play-ground, students are drilled twice a day by the College Havildar in the compound of the College, while occasionally they are given exercises in flag-signalling and fire-drills.

Hostels.—The European, Eurasian and Mahomedan students (8 in number) board and lodge in the rooms of the local Y. M. C. A., which is hardly a furlong north of the present College, while the Hindus and Christians (Indians) are accommodated in a spacious building about 100 yards south of the College.

These improvised hostels are fairly well furnished, and are provided with suitable bath-rooms, lavatories, kitchens, latrines, etc.

Students are encouraged to indulge in all manly games, (cricket, football, hockey and tennis), but the want of a suitable play-ground stands in the way of having their own teams. They join the students of other local colleges and play the above-noted games.

Reading Rooms.—There are two, one in the College and the other in the Hostel. Both of them are supplied with readable magazines, journals and papers. Scientific journals like *Nature*, the *Indian Forester* and the *Tropical Agriculturist* are also subscribed for.

The course of study is more or less similar to that at Dehra Dun, with slight modifications here and there, due to local conditions and requirements.

It is much to be regretted that the Government of Madras do not see sufficient justification for recommending the grant of Local or Special allowances to the Principal and the staff of Instructors and Assistant Instructors, in spite of the very strong recommendations of Sir St. H. Eardley-Wilmot and Mr. Lodge. The statement appended to the end of this article shows at a glance how liberally other provinces treat their educational officers who, it need hardly be pointed out, are picked men.

It would not, therefore, cause surprise if an officer on being selected as a member of the College staff were to endeavour to evade this and remain in his district. The remedy is quite simple.

Encouragement and sympathy would go a long way in obtaining the right sort of officers who would find it worth their while to come to and stick to the College.

The other serious point to which sufficient attention does not seem to have been paid up to date is the not unlikely event of there being frequent changes in the teaching staff which will be detrimental to progress.

Lastly it may be mentioned that it would be a good plan to select the College officers and inform them of their selection some time in advance of their actual postings, as that would enable the officers concerned to work up the subjects on which they may be expected to lecture when they join the College.

TABLE SHOWING SPECIAL ALLOWANCES GIVEN AT CENTRES OF FOREST EDUCATION.

Name of Province.	Name of the Institution and its Head-quarters.	Officers on the Staff.	Amount of Local or Special Allowance per month.
I. India ...	Imperial Forest College, Dehra Dun, for the training of candidates for the Provincial and Subordinate Services.	(*a*) President* ...	Rs. 200
		(*b*) Research Institute Officers and Instructors.	,, 150
		(*c*) Assistant Instructors.	,, 75
II. Burma ...	Forest School, Pyinmana, for the training of candidates for the Subordinate Service.	(*a*) Director ...	,, 100
		(*b*) Instructor ...	,, 75
		(*c*) Assistant Instructor.	,, 50
III. Bengal ...	Forest School, Kurseong, for the training of Deputy Rangers and Foresters.	(*a*) Director ...	,, 100
		(*b*) Instructor ...	,, 60
IV. United Provinces	Forest School, Ramnagar (as above).	Instructor ...	20 per cent. of his pay.
V. Central Provinces	Forest School, Balaghat (as above).	(*a*) Director ...	Rs. 100
		(*b*) Instructor ...	,, 50

* The President is also in charge of the Forest Research Institute and is allotted free quarters.

1*st October* 1912. (Sd.) V. SUBRAMANIA IYER.

THE CALCULATION OF THE YIELD BY NUMBER OF TREES UNDER THE SELECTION SYSTEM.

SIR,—In my article under the above heading in the February issue of the *Indian Forester* of the current year the undermentioned mistakes occur. As the original manuscript, which I have retained, is quite correct, it is evident that the mistakes are misprints, and I wish to draw attention to them in order that the text may be corrected :—

(1) *Page* 77, *line* 8 : *for* $y = \tfrac{1}{20} + \dfrac{\tfrac{20}{30}\mathrm{II}}{20}$

read $y = \dfrac{\mathrm{I}}{20} + \dfrac{\tfrac{20}{30}\mathrm{II}}{20}$.

(2) *Page* 77, 10*th line from bottom :*

for $\tfrac{1}{30} + \dfrac{\mathrm{II}}{30} + \dfrac{\frac{30-20}{25} \times \mathrm{III}}{30}$

read $\dfrac{\mathrm{I}}{30} + \dfrac{\mathrm{II}}{30} + \dfrac{\frac{30-20}{25} \times \mathrm{III}}{30}$.

(3) *Page* 79, *line* 8 :

for $y = \dfrac{\mathrm{I} + \frac{2p-t\mathrm{II}}{2p}\mathrm{II} + \frac{(p-t\mathrm{II})}{2p\,t\mathrm{III}} \times \mathrm{III}}{p}$

read $y = \dfrac{\mathrm{I} + \frac{2p-t\mathrm{II}}{2p}\mathrm{II} + \frac{(p-t\mathrm{II})^2}{2p\,t\mathrm{III}} \times \mathrm{III}}{p}$.

(4) *Page* 81, 3*rd line from bottom :*

for $y = \dfrac{\mathrm{I} + \left(\frac{1}{2} + \frac{f}{p} + \frac{f}{p}\right)\mathrm{II}}{p}$

read $y = \dfrac{\mathrm{I} + \left(\frac{1}{2} \times \frac{f}{p} + \frac{f}{p}\right)\mathrm{II}}{p}$.

(5) *Page* 82, *last line :*

$$for \quad y = \frac{\mathrm{I} + \left(\frac{1}{2} \times \frac{f}{p} \times \frac{2f}{p}\right)\mathrm{II}}{p}$$

$$read \quad y = \frac{\mathrm{I} + \left(\frac{1}{2} \times \frac{f}{p} + \frac{2f}{p}\right)\mathrm{II}}{p}.$$

(6) *Page* 83, *line* 3 *:*

$$for \quad y = \frac{\mathrm{I} \times \left[\frac{1}{2} \times \frac{f}{p} + (n-1)\frac{f}{p}\right]\mathrm{II}}{p}$$

$$read \quad y = \frac{\mathrm{I} + \left[\frac{1}{2} \times \frac{f}{p} + (n-1)\frac{f}{p}\right]\mathrm{II}}{p}.$$

(Sd.) R. S. TROUP.

TIMBER CONSERVATION.

It is difficult to say how much accuracy there is in the Progress Report of the Committee on Conservation of Natural Resources of the American Railway Engineering Association of Chicago, since the American State Forest Service is yet far from adequately organised; but nevertheless startling figures are put forward which are enough to show that the timber supply of the United States is reaching a critical point. By some method of calculation the conclusion arrived at is that the whole of the standing timber in the States at present totals 2,826 billion feet, that the total yearly growth is 7 billion feet, and the total quantity extracted each year is 23 billion feet. Thus, allowing for additions by growth, the stock is being depleted at the rate of 16 billion feet yearly, so that in 177 years not a stick would be left. In fact, allowing for a diminishing replenishment with a progressively reduced stock this catastrophe ought to overtake the country in very much less time, let us say, in 100 years, because a factor to be considered besides removal of timber is natural decay which in

some districts balances the yearly growth, since, from its inaccessibility, the timber cannot be removed. When this cataclysm comes upon the country, if the United States had its eye upon some other part of the world to go to for its supply well and good ; but it has not, because nowhere else is timber being reproduced with a large margin. The first remedy, therefore, is rigid economy for which there is apparently much room when it is stated that the consumption per head comes to 230 cubic feet, whereas in Germany it is only 37 cubic feet, and in France no more than 25 cubic feet. Next, attention must be turned to the enormous losses from fire which are said to represent annual average of 50 million dollars, neglecting the damage done to young growth. That this is almost wholly preventible may be concluded from conditions prevailing in well-managed European forests where losses from this cause are now negligible, the record for the Prussian forests being one-fifth of one per cent. Though a great many forest fires are started by sparks from locomotives the fault seems to lie wholly with the foresters themselves who, after logging operations, leave the forest in a state that invites conflagration. Locomotive sparks do not travel any great distance, and it is therefore the clear duty of the forest owners to make that distance safe by removing from it all that is readily combustible. Were the incidence of forest fires reduced to the same proportion as it now holds in Europe the 7 billion feet of additional timber each year in the whole of the American forests would very soon grow to a much larger figure. Then there are other obvious fields for improvement. It is said the quantity of timber growing on the 235 million acres of forest could easily grow on only 145 million acres, and therefore there is room for adding to the density of the growth by 80 per cent. ; and again, if the commoner species be gradually replaced by the best the outturn could be still further increased. In fact it is calculated that by better working the additional annual growth which is now reckoned at 12 cubic feet to the acre could be raised to 80 cubic feet per acre. Although, as stated earlier, an American forest service is still in a stage of infancy, the country thirty years ago began to awake to the necessity of doing something to prevent

the rapid waste that was going on and very naturally (as consumption was most prominent on its railways—a vast system which has now reached an enormous mileage approaching 250,000, or 40 per cent. of that of the whole world) turned its attention to the sleeper supply. It tried to eke out the supply by introducing preservative treatment, and though at first the policy was not vigorously pursued, it has now developed to an extent not equalled by any other country of the world, the quantity of timber so treated in 1910 being put down at 97½ million cubic feet. There has also been an attempt to get individual railways to engage in forestry operations so as to, in a measure, provide their own sleepers; but this has so far been taken up in a small way as companies are not keen to make investments that will become profitable perhaps thirty or forty years later. Those that received originally large grants of timber land, are, however, now planting and conserving their forests. Attempts are also being made by the free distribution of plants, to convert the prairie lands into timber-growing areas, a measure that in another half century ought to add very materially to the area of forest land.—[*Indian Engineering.*]

ECONOMIC ZOOLOGY—A NEGLECTED INDUSTRY.

The now well-known and we believe successful experiment of Sir William Ingram of *Illustrated London News* fame, who also possesses "Tucker's Valley," an important old-established estate in the north-west corner of Trinidad, West Indies, to introduce and acclimatize Birds of Paradise into Little Tobago, West Indies, coupled with repeated articles or suggestions in the columns of our contemporaries from time to time, on the advisability of transferring birds or animals of economic value from one part of the world to another, have caused us to publish the following remarks. Whilst in the Tobago experiment the initiative is due to Sir William Ingram, the actual and difficult task of transporting the birds, each in a separate cage, for they are very quarrelsome, was carried out by Mr. Wilfred Frost, of London, and we would say

that provided we have the man experienced in the ways of tropical (or other) birds and animals, and willing to devote the great care and attention to them that they need, there is practically no bird or animal of economic value that cannot be brought to London in the same way as Wickham brought the first Hevea rubber plants from the Tapajos plateau up the Amazon to Kew, and the species then sent on to elsewhere as supplies are called for and desired. The only query is, who can and will undertake such work? The Zoological Society, as at present constituted, we do not believe could or would do so. Under Mr. Bartlett in days gone by it could have done so, and although many have the idea that originally it was intended that the Society should undertake such work, on lines similar to Kew with economic plants, in return for certain privileges it enjoys, we could contend that the present secretary and council are not interested in, or at least have shown no signs of carrying out such work, and that a new society will have to be formed of members who have had long experience and a careful training in the tropics. Unless therefore a considerable amount of new blood be introduced into the present Council, we must look elsewhere than to those who run the "Zoo" for the introduction and acclimatization of animals into centres where *they do not already exist or are there only in small numbers*, and we are publishing these notes, in the hope and belief that many who are anxious to see our tropical colonies and dependencies flourish will come in and assist in the matter with their influence and advice.

We have discussed the question of economic zoology with many of our visitors from the tropics and all agree that it is a science or industry, whichever you choose to call it, that has been shamefully neglected, and that many centres are the poorer for this neglect. Whilst not blaming existing ostrich farmers for keeping that flourishing industry to themselves as much as possible, steps ought long ago to have been taken to spread the industry, for we are repeatedly receiving inquiries from India, etc., for books on ostrich farming, or addresses of those able to supply birds and eggs, showing how anxious many are to start such farms. This

is the class of work that the Zoological or similar society should undertake; but have they ever done so?

The prize of 10,000 francs offered by a French firm for the first *Garcero* or osprey farm established in French territory, where the feathers could be collected as is done with ostriches, without harming, and much less killing the birds, is an example that should be followed by this country. What has the Zoological Society done to encourage such an industry? Up to now the "Zoo" itself (*i.e.*, the Zoological Gardens,) has been the chief sign of the Society's existence, except for occasional reports of meetings. Of any sense of duty to the nation at large from an economic point of view, or any signs of the Society arranging to develop trade through the agency and help of their able members in all parts of the world, no hint or sign has, as yet, been vouchsafed so far as we can trace. We do not wish to infer that this is due to unwillingness on the part of members, or at least on the part of the bulk of them, but the Council seem so occupied in "setting their house (or houses) in order" that they have no time nor thought left for anything outside; that is, the majority of the Council have not. We believe, however, that if some of the members had their way things would be very different.

In the important review published by Mr. Douglas Dewar, I.C.S., in the *Indian Forester* in 1910 (p. 709) on our book "Aigrettes and Birdskins," * that gentleman expresses his perfect willingness to see osprey farms established in India, and further states that Mr. Frank Finn long ago suggested such a thing. Both these gentlemen, therefore, are in favour of establishing osprey farms in the same way as has been so successfully done with ostrich farms, and yet in the first place the ostriches were quite wild, and the feathers far less valuable than they are to-day. On osprey farms the birds could be bred in semi-captivity until, in the second or third generation, they would become sufficiently domesticated to be allowed almost complete freedom, provided steps were taken to prevent the birds being frightened sufficiently

* "Aigrettes and Birdskins," 138 pp., with Foreword by Sir J. D. Rees, K.C.S.I., M.P., price 5*s*. 4*d*., post free, TROPICAL LIFE Publishing Department.

to drive them away. None of those so far as we are aware who have been so busy preaching against the exportation of feathers from India, can claim to have had the experience, or to have published works on Indian and other bird-life, that can in any way approach those of Messrs. Dewar and Finn. Everyone, therefore, who wishes to see India developed in all ways possible will agree with us, that since both osprey and ostrich farms can be established in India to everyone's advantage, including the birds, which would then run far less chance of being exterminated than they do now, the sooner steps are taken to carry out this recommendation the better for all. Meanwhile it is interesting to note that according to the *Times of Ceylon*, Mr. John Hagenbeck the Hamburg naturalist, hopes to introduce ostrich farming into Ceylon, on lines similar to those of his brother Carl, who has been a successful breeder of ostriches at Stettingen, Germany, for the last three years, that, too, in spite of a somewhat unfavourable climate, it being damp and foggy at times in that district.

It was Mr. Finn, we believe, who recommended that the vicuna should be domesticated like sheep, camels, llamas, or goats, and their wool regularly collected by shearing the live animal, and shipped to Europe or America. Here we have an animal that at present is rapidly becoming scarce, yet easily bred and propagated under suitable conditions and of considerable economic value on account of the length, warmth, softness and lightness of its wool. The wool, we believe, at present is mainly if not entirely obtained by clubbing the animal to kill it, a method as brutal to the vicuna as it is wasteful from the point of view of economics. It would probably be found that vicunas and ostriches could often be bred, and would do well together on the same farm. Chinchillas in Chili, and many, possibly most, of the animals whose furs are so highly prized could surely be bred in fenced-in or otherwise confind areas in a similar manner, and their numbers thereby greatly increased so as to ensure supplies for trade purposes. Another example of what could be done in this way would be the breeding and rearing of horses where

possible on cocoanut estates as outlined in our leading article last month.

Peacock-tail feathers, known to the trade as "eyes," when there was such a rage for them in Paris a little while back, sold we believe, at 1*s.* to 1*s.* 6*d.* each. Think what a profit this would mean to the breeder of peafowls in India when even a penny a feather leaves a profit. So long as the present mischievous notification, in force throughout British India, prevents the export of feathers, peacock or otherwise, for trade purposes other than for fishing-tackle making, such an industry is unfortunately debarred to India, although the birds are classified as domesticated and the flesh makes excellent eating. If only the extremists and ultra-humanitarians (to use Mr. Lewis Harcourt's own phrase in the House of Commons on 27th June, in discussing experimenting on animals *re* beri-beri) could recognize that the feathers and even the skins of the birds could be used without causing any cruelty, or without fear of extermination (on the contrary, their numbers would probably greatly increase, as is the case with all animals and birds bred for the use of mankind), if this was only recognized and the restrictions removed, it is not difficult to realize what benefits would accrue to the thrifty inhabitants of India, and to the millinery trade of this country.

If, therefore, it could be arranged for the heads of the India and the Colonial Office, the more far-seeing members of the Zoological Society and others, to come together and discuss the matter, we feel certain that the science and practice of economic zoology could be, and would be, raised to the same level of utility as economic botany, and the results prove as beneficial to the species of avi-fauna utilized in the tropics and elsewhere, as their skins, fur, feathers, wool, etc., would prove useful to the arts and crafts of this and other countries. We hope and believe we shall hear more of the matter.—[*Tropical Life.*]

THE HYPNOTIC POWER OF SNAKES.

It is a popular belief that serpents have the power of capturing their victims by casting a mysterious spell over them. Even scientists have seriously considered this supposed mesmeric power over birds. Cuvier ascribed it to narcotic exudation, Audobon to the self-sacrificing audacity of nest-birds, Bonpland to the "instincts of curiosity and maternal devotion," and Russel Wallace to "optic influences akin to hypnotism." The latter theory is the most generally accepted, and in the rural districts of both Europe and North America bird-charming snakes are classed with such indisputable phenomena as fish-deluding anglers. Contemporaries of more than average intelligence will describe the glaring eyes of a rattlesnake that paralysed a youngster on his way to school, and maintain that they saw it charm down a squirrel from the top of a walnut tree.

An opportunity was afforded me recently of disproving the snake-charm theory. The pharmacist of a medical college had procured a number of live serpents for experiments with certain antidotes, and during the summer vacation boarded his pets in a suburb of Bennington, Vermont. They arrived in a moderate-sized box, and, with the owner's permission, my neighbour transferred them to a roomy outhouse with a close-fitting door and a wire-screen front. Through a glass window their movements could be watched in spite of two bundles of straw and other aids to comfort. Cold weather lethargised them, but on warm afternoons four or five of ten rattlesnakes and six moccasins were generally in motion.

Were they trying to get out? Their conduct rather suggested a sanitary penchant for moderate exercises and sunbaths; and there seemed no doubt that they had a memory for meal-times. General revivals repeatedly preceded the gong by a minute or two. The owner's signboard, "Dinner at 3 P.M.," attracted rather a surplus of sightseers, and when it became known that our experiments promised to solve a problem of ages entering, too, became superfluous; volunteer gifts of rats and blackbirds arrived in excess of our needs. Before the summer was over, our visitors had settled

the snake-charm controversy. Twenty-eight out of thirty intelligent witnesses agreed that there is no hypnotism about the matter.

Our first doubts were aroused by the complacency of birds and small mammals and their absolute indifference to the presence of their formidable fellow-captives. Within two feet of a coiled rattler a blackbird would alight on the rim of the drinking-basin and adjust the defects of his toilet, splashing water in the very face of the reptile that watched him with piercing eyes. Then after repeated sips, he would condescend to notice the crawlers, that had uncoiled by that time, and would finally hop aside just far enough to avoid a dispute regarding bathing privileges, but still within easy reach. Nor had the restlessness of rats anything to do with the dread of immediate danger. They were trying to gnaw their way out, but in the intervals of such efforts were apt to run straight into the pile of straw that formed the favourite rendezvous of the serpents.

The snakes, indeed, were in no hurry to abuse that confidence. When they did get ready they scorned hypnotic artifices. A gradual elevation of the head, a noiseless approach with a short halt in reach of the bird that was picking up crumbs in his feeding corner, then a slow contraction of coils, a snaplike dart, and a leisurely retreat, as from a task accomplished. The bird had taken wing, thoroughly alarmed now, and fluttered about the wire screen in the desperate hope of finding a loophole of escape. In less than thirty seconds the poison began to take effect. The bird clutched at the screen, with his head hanging further and further back, then relaxed his grip, dangled by one foot for a while, and came flopping down on the floor. It was not dead yet, but dazed, looking this way and that, and fluttering about in a strange, aimless fashion, and more than once right towards the destroyer, who at last began *to manifest an interest in its antics. Once or twice the serpent* coiled near the centre of the floor, seemed strongly tempted to risk a conclusive spring, but drew back again, fully aware, perhaps, that a better chance would be only a question of a moment. The bird was still on the floor, staggering to and fro, when a sideward

collapse marked the beginning of the end. Its foe watched it with lifted head. The chance had come. No risk of a rough-and-tumble fight now; the victim had ceased to flutter, and the old rattler quickly dragged it off to the straw pile. A full hundred experiments repeated this same sequence of manœuvres in all essentials.

The poison fangs of a snake have no proper roots, but terminate in a virus bag and are attached to the jaw by means of ligatures that make them movable to the extent of erection and retraction. This arrangement makes it difficult and rather superfluous for the snake to secure his victim at the first spring. The fangs are adapted only for a snake-bite, but their owner can afford to bide his time. The virus that has been known to overpower strong men in half an hour lethargises birds and small mammals in half a minute. Wherever stricken they are apt to collapse in sight, if not in direct reach, of their assailants, whose keen eyes detect the slightest commotion in the neighbouring weeds, but who would find it a very long time between meals if they had to rely on the hypnotic power of those eyes.—[*Scientific American.*]

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LIST OF TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

(PART II.)

BY H. H. HAINES, I.F.S.

[*Part I appeared in October* 1912.]

From the *Meliaceæ* onwards I have had the benefit of Mr. Donald's list prepared for the South Chanda Working Plan, and most of the Telegu names are taken therefrom.

XII.—TILIACEÆ.*

I have followed the grouping of the species in Grewia which is adopted in my Flora of Chota Nagpur. Mr. Drummond has recently, however, published an exhaustive account * of the synonomy of the Grewias of Roxburgh which, though it does not modify my ideas of the limitation of the species, calls for a few changes in the nomenclature which I have introduced. I regret

* Published in the Journal of Botany, November and December 1911. First part only received.

that Mr. Hole's work on Grewia is not at present available to me for consultation.

Grewia hirsuta, *Vahl.* Gursukri, *H.*; Ghatarni, *Mar.*

A shrub $1\frac{1}{2}$—4 feet high, usually with many stems from the root, stellately tomentose or stellately villose all over, with narrow oblong to ovate-lanceolate or broadly oblong serrulate very shortly petioled leaves. Fl. ploygamous or I-sexual white, or sepals first white then turning colour inside.

Buds ovoid under $\frac{1}{4}''$. Fruit pilose with long deciduous hairs, fleshy and sweet with a crustaceous rind. Fl. *July—Sept.* Fr. *Nov.—Jany.* Found in the forests in all divisions. Fruit eaten and is given in dysentery and diarrhœa.

Grewia flavescens, *Juss.* (Syn. G. pilosa of Flora of Chota Nagpur and of Mr. Witt's list for Berar.)

A large sub-scandent shrub with sharply 3—4-angled stems. Branches, leaves and inflorescence hirsute with stellate hairs, not villous. L. oblong or broader upwards, usually cuspidate. Flower-buds oblong mostly constricted in the middle $\frac{1}{3}$—$\frac{1}{2}''$ long before opening. Stigmas 4 spreading. Fruit closely covered with very *short* stellate hairs. Dhaba and Ghot ranges (S. Ch.)

Grewia abutilifolia, *Juss.*

(A specimen of this plant from Chota Nagpur was wrongly named for me G. sclerophylla, *Roxb.*, which is *not* a synonym, and hence G. sclerophylla in the Flora of Chota Nagpur is an error.)

A coarse bushy shrub about 4 feet high with stellately tomentose branchlets, large roundish or broadly elliptic leaves, often somewhat 3—4-lobed, serrate or denticulate closely stellate, especially beneath. Petiole ·5—1″. Fls. ·7—·9″ diameter white in subsessile axillary umbels the petals only ·1″ long. Fruit globose $\frac{3}{4}$ – 1″ diameter with 2·4 rugose pyrenes. (The fruit is much shrunk in dry specimens and therefore usually described as $\frac{1}{3}$—$\frac{1}{2}''$ diameter.)

Fl. *Aug.* Fr. *Nov.—Feby.* (The old dry fruit remaining long on the branches.) More or less evergreen. Balod range and North Shawa (*Rai.*); N. and S. Ch.; Nagpur.

Grewia disperma, *Rottl.* (Syn. G. lævigata, *Vahl.*) Ghaturli, *Mar.* (*S. Ch. W. P.*)

A small tree with shortly pubescent slender branchlets,' narrow 3·6″ by 1½—·2″. Flowers white 1—1½″ diameter succeeded by simple, 2-lobed, or 4-lobed green fruits.

Fl *June.—Oct.* Fr. *Dec.—March.*

Evergreen. Chiefly along nalas on metamorphic rocks.

S. Ch., frequent; Sitanala, etc. (Rai.); nala on Sonthipahar 2,000 feet, Pantora range (Bil.); Baihar and Raigarh (Bal.); Lorm forests (Bil.).

Grewia tiliæfolia, *Vahl.* Kesela, *Gondi*; Dhaman *H.*; Kasui *Gondi* (Bal. W. P.)

A naturally straight tree with very broadly ovate to obovate mostly unequal sided leaves, slender petioles up to 1″ long usually thickened at the top, mostly *falcate* stipules and numerous yellow flowers with their peduncles shorter than the petioles. Fruits mostly *didymous*.

This is the 'Dhaman' *par excellence*, the cordate base of the leaf is usually auricled on one side, the leaf surfaces *both* green, sub glabrous beneath even when young but occasionally stellate pubescent states occur together with more tomentose flower buds when herbarium specimens are sometimes confused with 'rotundifolia.' The short peduncles and relatively long petioles of 'tiliæfolia' will then usually be a safe guide. Petals of tiliæfolia are also much shorter.

In the field the smooth grey bark of tiliæfolia compared with the rougher black bark of 'rotundifolia' and the habit and blaze easily discriminate the two.

Common in all divisions. Fl. *May—June.* Fr. *Sept.—Oct.*

Largely cut out for bhangry poles, etc.

Grewia sapida, *Roxb.*, Phalsa, *H.*

An undershrub with annual (or often perennial, if not burnt) shoots from a woody rootstock, broadly oblong to sub-orbicular or obovate obtuse or acute leaves green or hoary beneath usually with a cuneate 5-nerved base, very short petioles and very long peduncles $\frac{1}{2}$—$1\frac{1}{4}''$. Fruits globose or somewhat lobed.

Fl. *April—June.* Fr. *May—July.*

Topla, etc. (Bal.) frequent; Bil.; and probably other divisions.

Fruit eaten.

Grewia celtidifolia, *Juss. Vide* Drummond in Journal of Botany, page 300 (Syn. G. elastica, *Royle* and G. vestita, *Wall.* and G. eriocarpa, *Juss. fide* Drummond) Dhaman, *Vern.*

Tree with tomentose shoots, ovate, oblong or elliptic acuminate 5—7-nerved leaves tomentose when young and often persistently white or tomentose beneath when old, with oblique but not cordate base. Petioles short, usually under .5″ in large leaves, stout, uniform or somewhat clavate. Stipules linear to setaceous. Peduncles few to many usually tomentose and divaricate. Bracteoles narrowly linear or setaceous. Buds sub-globose to oblong. Gonophore present or absent. Fruit globose under $\frac{1}{4}''$ diameter.

Fl. *April—May.* Fr. *Oct.—Jany.*

Hills and plateaux of Bal. and Bil. Hingni range (N. W.); Bh.

This tree again exhibits a series of forms much as in Chota Nagpur. In Baihar and Hingni the form with oblong leaves green beneath occurs, on the Mandla-Bilaspur boundary a beautifully white tomentose form with oblong acuminate leaves. Both these correspond more to G. vestita, *Wall.* At Pachmarhi (outside our area) I collected the form with large *ovate leaves, very gibbous* at base above and white tomentose beneath, coming very near to G. elastica of Royle, and very similar to a Parasnath form, and to G. elatostemoides, *Coll. et Hems.*

Grewia Rothii, *D. C.* Gatarni, *Mar.* Bansuli, *Gond.* (Bil.) ; Bhansuli, *Chh.*

A pretty shrub or, rarely, a small tree with hoary branchlets, ovate-lanceolate or lanceolate acuminate 3—5-nerved leaves always beautifully white beneath. Stipules broadly linear to linear-subulate equal or exceeding the petiole. Peduncles slender ·5—1" long with usually 3 very slender pedicels clavate beneath the flower and linear bracts ⅛" long. Fruit ¼" hoary, ultimately purple.

Frequent in undergrowth in the forests of all divisions.

Fl. *April—Sept.* Fr. *June.—Oct.*

Grewia rotundifolia, *Juss.* Bari gatarni (N. Ch.)

A small usually crooked tree with broadly ovate, broadly elliptic or orbicular leaves, young often subequal at base, old usually oblique denticulate, or occasionally coarsely toothed, easily recognised by the persistent tomentum or pubescence which give a grey-green-colour beneath. Flowers very numerous, tomentose, on slender peduncles which *considerably exceed the young* ·2—·3" petioles, and are usually twice as long. Fl. buds large wooly globose or broadly ellipsoid until ripe. Fl. *April—May.*

Chiefly in the western divisions of N. and S. Ch. (on sandstone) and N. W. (on trap) (almost gregarious near Rampuri. Kondhali range) less abundant eastwards, and not yet recorded from Bal. or Bil.

All the **Triumfettas** have yellow flowers, arranged in spiked fascicles, and remain open up to mid-day only.

Triumfetta pilosa, Roth.

A shrub 3—6 feet high with stellately hairy stems and simple ovate-lancoeolate leaves with sub-cordate base softly stellately hairy both sides. Conspicuous in fruit from the heads of hooked spines being ¾—1" diameter.

Fl. *Sept.—Nov.* Fr. *Nov.—Jan.* but old fruits often persist till April.

In shady forests. Sonakhan, Pantora, etc. (Bil.); Bal., frequent.

Triumfetta rhomboidea, *Jacq.*

An undershrub 3—4 feet with more or less pubescent branches and 3-lobed 5—7-nerved leaves with sub-cordate base stellately hairy, especially on ribs beneath. Fruits with the minutely-hooked spines $\frac{1}{4}''$ diameter.

Fl., Fr. most times of the year except the driest.

Chiefly in open forests and open ground, very common in all divisions. Yields a fibre.

Triumfetta rotundifolia, *Lam.*

An undershrub 3—4 feet with sub-orbicular scarcely lobed leaves ·5—1·5″ diameter, white beneath. Fruits globose or ellipsoid $\frac{1}{4}''$ long.

Open waste ground, very common in the western divisions.

Fl., Fr. at same seasons as the last.

Corchorus olitorius, *L.*, **C. fascicularis,** *Lamk.*

C. acutangulus, *Lamk.*, and **C. trilocularis,** *L.*, are all common herbs of which the leaves are eaten in the C. P. The first (Jute) is called *Chichura* in Nagpur, where they often occur as weeds of cultivation.

XIII.—LINACEÆ.

Reinwardtia trigyna, *Planch.*

A small shrub 2—4 feet high with green herbaceous branches and bright chrome-yellow flowers 1—$1\frac{1}{2}''$ diameter, on numerous small axillary branchlets.

Usually on shady banks near streams. South Sihawa (Raipur); Bilaspur; Fl. *Oct.—Feby.*

Erythroxylon monogynum, *Roxb.* Ali Chattu, *Tel.*

A shrub with the young twigs scaly with persistent stipules and small oblanceolate to obovate leaves, usually 2 only or clustered on the ends of the branchlets, resembling those of a Berberis.

Flowers 1—2 axillary and from leaf scars. ·25″ diameter. Fruit ·3″ *oblong*.

Venkatapur, South Chanda.

This interesting shrub was among some dried specimens which Mr. Rama Rao, Forest Ranger, collected in South Chanda.

XIV.—MALPIGHIACEÆ.

Hiptage Madablota, *Gaert.*

A very large scrambling or climbing shrub with elliptic leaves 4—7″ long and snowy white flowers with one yellow petal. Each carpel in fruit has one large central erect wing and two smaller lateral.

Evergreen. Fl. *Feb.—March.* Fr. *May.*

In ravines Bilaspur, Balaghat, Raipur, North and South Chanda, not common.

Aspidopterys cordata, *A. Juss.*

A tomentose climber with orbicular cordate leaves 5—8″ diameter and lax panicles of small white flowers. Fruit of samaras.

Fl. r.s. Fr. *Nov.—Dec.*

Especially near nalas Umrer Range (Nagpur-Wardha); Nagpur, Graham. North Chanda.

XV.—ZYGOPHYLLACEÆ.

Balanites Roxburghii, *Planch,* Hingan, *H.;* Ringri, *Tel.*

A very thorny grey-green shrub or small tree with alternate coriaceous pinnate leaves with only one pair of leaflets. Yellowish green flowers ·3″ in capitate cymes. Fruit yellowish 1½—2″ long.

Fl. *March—May* (also *Nov.*). Fr. *Nov.*

Common, chiefly in the western divisions of Nagpur-Wardha and North Chanda, South Chanda. Partial to trap and cotton soil.

XVI.—RUTACEÆ.

Murraya exotica, *L.* Pitondi *Gond*; Ban Mirchi, *Bhumia.*

A handsome shrub or small tree with pinnate leaves, small dark-green shining leaflets and white fragrant flowers.

Ravines and cool rocky places, especially in the higher elevations of Lormi (Bilaspur) and Balaghat ; also Paraswara Forest and Batkari Block (Balaghat).

Fl. *April—July*. Fr. *Dec.—Jany.*

Evergreen.

Murraya Koenigii, *Spreng.*

A shrub occasionally cultivated in gardens. It is only referred to here in consequence of its being reported by Mr. Witt from all divisions of Berar, except Amraoti. It extends throughout the comparatively moist zone at the foot of the Himalayas and along the west of the Peninsular, but that it should be wild in the dry Berar forests and not in the rest of the C. P. is peculiar.

Limonia acidissima, *L.* Padara Kawat, *Mar.;* Morphai torelka, *Tel.*

A small straight tree with pinnate leaves recognizable from the winged rachis, usually 5—7 leaflets and 1—2 axillary thorns. Flowers, small pale yellow. Fruits small globose black ½" diameter.

Sub-deciduous at time of flowering.

Fl. *May—June.* Fr. *Nov.—Dec.*

Dhaba Forest (South Chanda).

Feronia Elephantum, *Correa.* Katbel, *H.*; Vellaga *Tel.* (South Chanda Working Plan); Kawit, *Mar.*

A thorny tree with dark-green pinnate leaves, opposite small entire leaflets and green and red (anthers red) flowers ⅓" diameter. The fruit is the well-known wood-apple.

Especially on cotton soil in North Chanda, Nagpur-Wardha and to a less extent in all districts.

Fl. *March—April.* Fr. *Nov.—Jan.*

Aegle Marmelos, *Correa.* Bel, *H.;* Mahaka dibur, *Gondi.;* Pater, *Tel.* (*South Chanda Working Plan*).

A thorny tree with 3-foliate leaves and greenish-white flowers 1" diameter in panicles.

All divisions. Common on metamorphic rocks.
Fl. *May—June.* Fr. *May—June* (of following year).

XVII.—SIMARUBACEÆ.

Ailanthus excelsa, *Roxb.* Ghoranim, *H.*; Maharukh, *Vern.* (*North Chanda Working Plan*).

A tree with light-coloured bark, stout hoary tomentose branchlets, large pinnate leaves with 10—13 pairs of very coarsely-toothed leaflets, panicles of small flowers and winged fruits.

Fl. *Feby.—March.* Fr. *May.*

Found in all divisions especially near villages. Not common in the forests, as its winged seeds apparently require bare ground for germination.

XVIII.—OCHNACEÆ.

Ochna Gamblei, *King;* Turmura, *Gond;* Gurbelia, *Chh.;* Rakhat Rohan *H.;* Sonari, Kukkamori, *Tel.*

A small very pale glaucous tree with sessile, sometimes cordately based leaves and large yellow flowers $\frac{3}{4}$—1" diameter in corymbs at the ends of the branchlets.

South Chanda (Dhaba, Ghot, etc.); Raipur (Balod Range) on marl. Fl. *April* when nearly leafless.

Ochna squarrosa, *Roxb.*

A small glabrous tree with leaves not glaucous, with very numerous fine oblique secondary nerves and finely serrate, is found in Cherla (recently transferred to Madras) according to Mr. Donald.

Ochna pumila, *Ham.*

A pretty undershrub with a long stout rootstock from which is sent up annually shoots 8—18" high, bearing broadly oblanceolate finely serrate leaves 3—6" long and umbels of large bright yellow flowers $1\frac{1}{2}$" diameter.

Common on the Raigarh, Baihar and Bilaspur plateaux.

Fl. *April—June.*

XIX.—BURSERACEÆ.

Boswellia serrata, *Roxb.* Salai, *H.;* Anduga, *Tel.* (*South Chanda Working Plan*).

A tree with the bark pealing off in thin papery flakes, pinnate leaves with opposite coarsely crenate-serrate leaflets and recemes of smallish white flowers.

Fl. *Jany.—March.* Fr. *April—May.*

Deciduous *Jan.—June.*

All divisions, especially common on low hills, scarce in the Sal forests.

Can be easily grown from large cuttings. Wood can be used for charcoal and is sometimes cut for planks. It is the chief wood used for matches at the Kota factory in Bilaspur.

Garuga pinnata, *Roxb.* Ghogar, *H.* (*South Chanda Working Plan*); Gargu, *Gondi* (*Balaghat Working Plan*); Garga, *Tel.* (*South Chanda Working Plan*); Kekar, *Gondi*; Kekara, *Mar*; Kanhayan, *Mar.*; Mohdi, *Baiga*; Gari, *Kamar*; Garirukh, *Chh.*

A tree with pinnate leaves and opposite crenate pubescent leaflets. Yellow campanulate flowers in panicles from the ends of the leafless branches. Fruit globose ¾″ diameter.

Fl. *March—April.* Fr. *June—Augt.* Leafless *March—May.*

In all divisions, on cool sides of hills and in ravines. Common in Sonawani ravines (Balaghat); common in Sihawa forests (Raipur); frequent among hills in Bilaspur; Indapur, along nalas (Nagpur).

Bursera serrata, *Colebr.* Lindwi, *Chh.*

A tree with pinnate leaves and opposite entire or more or less serrate leaflets pubescent on the nerves beneath Very small green flowers in lax panicles from the leaf axils. Fruit globose ·5—·75″

Fl. *April.* Fr. *May.*

Rare in the C. P., Dukawa and Ardarha nalas, South Sihawa (Raipur).

XX.—MELIACEÆ.

Azadirachta indica, *A. Juss.* Nim, *H.*; Sedyapa, *Gondi*; Yapa, *Tel.* (*South Chanda Working Plan.*)

A handsome tree with dark-green pinnate leaves with serrate leaflets. Flowers white, ·3″ diameter, in axillary panicles. Drupe yellow oblong ·5—·75″ long.

Fl. *March--May.* Fr. *June—July.* Evergreen.

It is naturalized in several forests, *e.g.*, Karandla Working Circle (Nagpur-Wardha), Minjhari Working Circle (North Chanda), South Chanda near Singampalli, Dighori block, grows well on cotton soil and trap, and has been found a most useful tree in re-stocking the Seminary hill in Nagpur. It grows readily from seed, which germinates at the beginning of the rains.

The oil is much used in parasitic skin diseases.

Melia Azedarach, *L.* Bakain, *H.* Persian Lilac.

A pretty tree with 2-pinnate leaves and panicles of lilac-coloured flowers. Drupes yellow nearly globose.

Fl. *May—June.* Fr. *Nov.—Dec.*

It is more or less leafless from December to April, which discounts its value for ornamental purposes.

Cultivated only.

Cipadessa fruticosa, *Blume.*

A small pubescent tree or large shrub with long sub-sarmentose branches, pinnate leaves with 7—11 opposite variously toothed leaflets and axillary or extra-axillary small cymose panicles of small white flowers. Fruit ·2 diameter.

Rare. South Sihawa (Raipur).

Soymida febrifuga, *A. Juss.* Rohan, *H.* Soimi, *Gondi;* Sumi, *Tel.* (*South Chanda Working Plan*).

Usually a small or moderate sized tree with thick wrinkled branchlets and pinnate leaves 9—18″ long, usually red when young

and often with permanent red rachis and mid-rib of the sessile leaflets. Flowers greenish-white in large terminal panicles. Fruits large, woody when ripe.

Common except in the Sal areas. Grows abundantly on cotton and calcareous soils.

Fl. *April—May.*

Fr. *May—June.*

The poles are valued for building.

Cedrela Toona, *Roxb.* Var. Tuni, *H.*

A handsome tree 50—60 feet with pinnate leaves $1\frac{1}{2}'$—to 2′ long and 10—16 pairs of leaflets (shorter leaves occur near the inflorescence) which are very oblique lanceolate acuminate and up to 6″ long. Panicles of campanulate white flowers drooping one-third to half as long as the leaves. Capsule ·7″.

Fl *March—April.* Fr. *May—June.*

New leaves in March and April.

Dhansua, Baihar and Raigarh ranges in Balaghat, on the plateaux along valleys. Lormi Forests, Bilaspur, similar places. This also appears to be the same as the Pachmarhi Toon, and will probably be identical with the Melghat species, but there are slight differences between (*a*) the Balaghat specimens, (*b*) the Lormi specimens, and (*c*) the Pachmarhi specimens.

(*a*) Flowers 5 m.m. long, filaments glabrous, anthers *not* apiculate. Branchlets and petioles pubescent when young or with fine ferruginous tomentum. Panicles shorter than leaves.

(*b*) Flowers only 4 m.m. long and the rest much as in (*a*).

(*c*) Flowers 5 m.m. long, filaments slightly pilose or puberulous. Anthers apiculate. This may be De Candolle's Var. *decanna.*

The young leaves of all are coarsely *serrate.* The tree thrives best on sandy soils. It has a beautiful red wood as in the typical Toon.

Chloroxylon Swietenia, *D.C.* Bhira, *H.*; *Mar.*; Billu, *Tel.* (South Chanda Working Plan); Bilgu, *Gond.*

A small or moderately sized tree with thick corky bark, pretty grey, or glaucous-green pinnate foliage with 10—20 pairs of small gland-dotted leaflets.

Flowers white in panicles. Capsule $1-1\frac{1}{2}''$.

Fl. *March—April.* Fr. *May—June.* Leafless Feby.—April.

Common in all divisions and attains timber size on sandy loams in Chanda. Much prized as poles. A very useful tree, as it will grow on the dry hard sandstone plateaux of Raipur, etc., as well as in cotton soil, and it thrives on heavily-grazed ground, owing to the acrid juice making it unpalatable even to goats.

XXI.—OLACACEÆ.

Olax scandens, *Roxb.* Ardhaphal, *Mar.*; Chit, *Chh.*; Kurpodal, *Gond.*; Harduli (*North Chanda Working Plan*); Turkanepa, *Tel.*

A usually scrambling or climbing shrub with trunk attaining 1 foot diameter, pubescent branchlets and white flowers in short racemes. Fruit $.3''$ diameter more than half enclosed in the succulent yellow calyx tube.

A root parasite (like the Sandal), common in all districts, especially North Chanda.

Fl. *April—June.* Fr. *Oct.—Dec.*

Opilia amentacea, *Roxb.* Dauer Bel, *Mar.*; Nakargand, *Mar.* (f. Donald); Elkariakar, *Gond.*

A scandent shrub with fulvous-tomentose branchlets and lanceolate or lanceolate-ovate leaves $1\frac{1}{2}-4''$ long with distinct fine and irregular secondary nerves. Flowers very small greenish slender-pedicelled racemed in threes, concealed when young by orbicular ciliate bracts. Drupes $\cdot 3''$.

Fl. *April—May.* Fr. *July.*

A root parasite.

Dhaba, etc., South Chanda, frequent.

Cansjera Rheedii, *Gmel.* Haradphuri, *Mar.*; Kurpodol, *Gond*; Kokuti, *Maria.*

A large scandent shrub with pubescent green branchlets and shining ovate or lanceolate-ovate leaves $1\frac{1}{2}$—4″ long, minutely translucent dotted with fine indistinct secondary nerves. Flowers very small yellowish sessile tomentose in tomentose spikes $\frac{1}{2}$—1″ long. Bracts minute subulate. Fruit scarlet ellipsoid ·3—·5″ sessile.

Fl. *Nov.—Dec.* Fr. *April—May.*

A root parasite. Very common in Chanda, especially South Chanda, where it has been mistaken for Olax.

XXII.—CELASTRACEÆ.

Celastrus paniculata, *Willd.* Malkamni, *H.*; Rungel. (*North Chanda Working Plan*); Dhimarbel, *Mar.* (f. Donald).

A scrambling or climbing shrub with long lenticellate branches, alternate obovate serrulate leaves, green flowers $\frac{1}{8}$″ diameter in terminal panicles and yellow 3-lobed capsules with red arilled seeds.

Common. Fl. *April—June.* Fr. *Oct.—Jany.*

The oil is used for rheumatism and for burning.

Gymnosporia montana, *Roxb.* Bharati, Baikar (*North Chanda Working Plan*); Dante, *Gondi.* (*South Chanda Working Plan*); Danti, *Tel.* (*South Chanda Working Plan*).

A large shrub with the branchlets usually ending in thorns which often bear leaves and flowers. L. leathery $1\frac{1}{2}$—2″ elliptic or obovate rounded at apex.

Flowers $\frac{1}{4}$″ white in axillary cymes. Capsules not woody, about ·2″ diameter usually purple when ripe.

Fl. *Oct.--Nov.*

Especially common in the western divisions (Nagpur-Wardha and North Chanda and South Chanda) on trap and cotton soil.

Elæodendron glaucum. *Pers.* Aran, *Mar.;* Jumrassi, *H.;* Bhutanksham. *Tel.* (*South Chanda Working Plan*).

A small tree with opposite (or alternate on some shoots) dark-green crenate or serrulate leaves 5″ by 2½″ and lateral divaricate corymbose cymes of small flowers with greenish-white petals. Drupes ·5″ long.

Nearly evergreen. Fl. *Sept.—Dec.* Fr. ripens about February.

Common on trap (Nagpur-Wardha and Chanda) and on metamorphic rock.

XXIII.—RHAMNACEÆ.

Ventilago maderaspatana, *Gaertn* Pem, *Gond.;* Chunuguru, *Tel.*

A large scandent shrub with green branchlets, bifarious elliptic or oblong leaves 3—6″ long and pubescent fascicles of small yellow-green flowers arranged in interrupted panicles.

Fruit produced into a narrow-oblong wing seated upon or half sunk in the adnate calyx-tube.

Fl. *Sept.—March.* Fr. *March.* Evergreen.

Yields an oil. Mr. Donald states that Var calyculata is the form in South Chanda.

Zizyphus Jujuba, *Lamk.* Bor, ber, *H.;* Regi, *Tel.* (*South Chanda Working Plan*).

A shrub, or small tree with usually drooping branches, young tomentose. L. 1·5—3″ tomentose beneath. Small green flowers in dense axillary tomentose cymes or clusters. Drupes ½—¾″ diameter.

Fl. *March.—June.* Fr. *Jan.—March.* New leaves March—April.

Common and apparently wild in many places, frequent on cotton soil. The tree form is usually only on possible sites of old cultivation, but it is common in the Zemindari forests in the east of Bhandara.

Zizyphus rotundifolia, *Lamk.* Jhar Ber, *Mar.*; Ranber, lahanber (*North Chanda Working Plan*).

A small much branched shrub with slender divaricate zigzag branches, pubescent when young. L. = ·5—1" sub-spinulose dentate towards apex with grey tomentum beneath. Stipular thorns one straight slender ·5—·75" long, the other hooked. Flowers in axillary sessile, pubescent cymes. Drupes ·3" diameter, reddish when ripe, shining.

Fl. *Oct.—Dec.* Fr. *Dec.—Feby.* Fruit eaten.

On open waste lands, often on cotton soils in the western districts? Perhaps elsewhere, but is easily mixed up with some shrubby forms of **Zizyphus Jujuba,** and the forms require further investigation.

Zizyphus Œnoplia, *Mill.* Ironi, Yeruni, *Gond.*; *Mar.* Makoya, *H.*, *Chh.*; Porki, *Tel.* (South Chanda Working Plan).

A thorny shrub becoming a large climber festooning the highest trees. Trunk armed with conical spine-tipped woody bosses. L. oblique 1—2·5" with brown silky adpressed hairs beneath. Cymes under ·5" long. Fruit ·25" black, shining, eaten.

Fl. *June—July.* Fr. *Nov.—Dec.*

Common in most districts but especially on the Chanda sandstones where it becomes a terrible pest, producing an impenetrable thicket in many places.

Zizyphus xylopyra, *Willd.* Khatbor Ghoti, *H.*; Ghœnt, *Baiga* (*Balaghat Working Plan*); Gutul *Bhumia.*

A small usually crooked tree with spreading crown, with or without thorns, but the young plants are very bushy and very thorny. L. elliptic or ovate 1·5—3" more or less pubescent beneath. Green flowers in peduncled dense cymes axillary, or panicled on lateral branches. Drupe globose 1—1·5" diameter, flesh dry when ripe.

Fl. *April—June.* Fr. *Jany.*

Wood hard and durable.

In all districts, very common.

Zizyphus rugosa, *Lamk.* Pitondi, *Chh.*; Katakuli, *Gond.*; Deo ghoti, *Vern.* (South Chanda).

A large shrub with long pendent or scandent branches, large elliptic serrulate leaves 3—6" long. Flowers ¼" greenish-yellow in large panicles. Fruit 3—·5" white fleshy, edible.

Fl. *Feby.—March.* Fr. *May—July.*

Balaghat, on the plateaux and ghats, common; South Sihawa (Raipur), common; South Chanda, frequent; Bhandara; Raj Nandgaon; less common in other districts.

Helinus lanceolatus, *Brandis.*

A bright green slender shrub climbing by means of tendrils (modified branches) with ovate or lanceolate entire leaves about 2½" long and small yellow flowers in slender peduncled, often panicled, cymes. Fruit ½" diameter, the putamen finally separating into 3 crustaceous pyrenes.

Fl. *Jany.—April,* Fr. *April.—May.*

Common on Baihar ghats and on the plateau (Balaghat); Lormi forests (Bilaspur) on rocky ground.

XXIV.—AMPELIDACEÆ.

Vitis repanda, *W. and A.* Gonvehli; *Gond.* Gendal *Nag.* (f. Graham) Dokarbela, *Chh.*; Godina tige, *Tel.*

A large climber with soft stem and corky bark, large simple deeply cordate usually repand or denticulate leaves (young often with large sharp teeth) and slender peduncled tomentose, cymes of small flowers. Young parts all densely tomentose. glabrescent.

Frequent in all divisions. Fl. *May—June* on the new shoots. or *July—Aug.* (Graham). Deciduous.

The stem yields a quantity of drinkable water.

Neither Hole nor Witt mention this species, but they give the name Dokarbela to V. latifolia to which it is also sometimes applied. It occurs in the Northern Circle, as I have seen it below Pachmarhi.

Vitis Linnæi, *Wall.* Jangli Angur, *H.* (Angur is the Grape Vine).

A weak climber with corky bark, very membranous leaves which are shallowly lobed and coarsely toothed, basal sinus wide and shallow or base nearly truncate, clothed with a short curly pubescence beneath. Flowers minute with very caducous petals. Fruit pale purple 1 seeded on deflexed pedicels.

Nagpur-Wardha, common. South Chanda. Fl. r.s. Fr. *Oct.—Nov.*. Probably in other divisions, but it dies down in the cold weather.

Vitis latifolia, *Roxb.*

An extensive scarcely woody climber glabrous (or nearly so) everywhere except the rachis of the inflorescence with simple 3—7-angled or lobed leaves 4—8″ long and broad, deep brown-red flowers and black succulent berries.

The lower leaves are often 3-lobed nearly to the middle.

Common. Fl. *June—Aug.* Fr. *Sept.—Oct.* Dies down in the hot weather. Berry eaten.

Vitis tomentosa, *Heyne.*

Similar to last, but always with leaves densely tomentose beneath and other parts also more or less tomentose, leaves all deeply 3—5-lobed, often attaining 10 inches both ways. Flowers red in divaricate cymes on a peduncle under 1″ long, which is carried on a leafless shoot 3—6″ long ending in a forked tendril.

Fl. *July—Sept.* Fr. *Oct.—Jany.* South Chanda. Probably in all divisions as it is common in western Bengal.

Vitis trifolia, *L.*

A weak sub-succulent climber, pubescent when young with 3-foliolate petioled leaves, crenate leaflets and small greenish flowers in lax divaricate long-peduncled cymes.

Common. Fl. *June—Aug.* Fr. *Oct.—Jany.*

Vitis setosa, *Wall.* Tiphankhand, *Vern.* (Graham).

A weak succulent climber, covered with glandular bristly hairs, with 3-foliolate sessile leaves, and serrate-dentate leaflets.

Nagpur-Wardha, common.

Fl. *July—Aug.*

Leaves used to dress wounds on oxen (*Graham*).

Vitis auriculata, *Roxb.*

A large sub-succulent scrambler with digitate 5-foliolate leaves long-petioluled crenate-serrate leaflets and large divaricating cymes. Fruit ·5—·75″ diameter, reddish when ripe.

Fl. r. s. Fr. *Oct.—Dec.*

North Chanda.

Leea macrophylla, *Roxb.*

A robust herb 2—3 feet from a perennial rootstock with few simple (at least the lowest) ovate-cordate leaves, of which the largest may be 1—2 feet diameter. Small white flowers in sessile corymbs.

Fl. *June—July.* Common, but only evident in the rains.

Leea aspera, *Edgw.*

Shrubby with stems 5—10 feet which die down annually, lower leaves 2-pinnate, upper pinnate. Leaflets elliptic or ovate with strong secondary nerves which bifurcate near the margin and give a branch to each pair of teeth, usually with scattered short rigid hairs and dotted between the nerves above. Corymbs peduncled. Berries slaty-green, finally black.

Chanda, common.

Fl. *July.—Sept.* Fr. *Nov.—Dec.*

Leea robusta, *Roxb.* Dara chettu, *Tel.*

A large sub-woody shrub 4—6 feet with more or less pubescent or tomentose branchlets, large 2—3-pinnate leaves with leaflets pubescent or sparsely strigose beneath and large branched, usually geminate corymbs 7—15″ diameter.

The secondary nerves are 6—13 pairs above the 5-7-nerved base of the leaflets Fl. r.s.

South Chanda. Probably elsewhere.

Leea sambucina, *Willd.*

A woody shrub with large 2-pinnate leaves glabrous beneath and *very large coarsely doubly-serrate leaflets up to 12" by 3½".* Secondary nerves 7-15 pairs much raised beneath, curved within the margin. Teeth 3—5 times as many as the secondary nerves. Flowers green in sub-sessile corymbs 3—6" diameter.

Fl. *June—Aug.* Fr. *Sept.*

Bilaspur.

XXV.—SAPINDACEÆ.

Schleichera trijuga, *Willd.* Kusam, *H.*; Puski, *Tel.*

A handsome dense foliaged tree with pari-pinnate leaves and 2—4 pairs of opposite entire leaflets 3—10" long, the basal ones smallest. Flowers inconspicuous greenish-yellow in numerous lateral racemes appearing with the new, often deep-red, foliage. Fruit ovoid 1—1½" coriaceous.

In all divisions, but especially in Raipur. Not common in Nagpur-Wardha.

Fl. *Feb.—Apil.* Fr. *June—Aug.*

The timber is good. The aril and kernel of the seeds are eaten. An oil is expressed from the seeds.

Dodonæa viscosa, *L.* Mehndi. *H.*; Kharata, *Mar.* Lahan bkhandi *Mar.* (f. Donald); Paliwaili, *Tel.*

A light green shrub attaining 10 feet high with simple oblanceolate glabrous sub-sessile leaves 1—3·5" long and short cymes of green flowers. Fruit membranous 2—4-winged.

Fl. *Nov.—Feby.* Fr. *Oct.—Nov.*

The distribution is peculiar, but generally speaking, it avoids trap and favours sandstone. In the Sonawani range (Balaghat) it is

found on ridges of white clay schist, but is local. In Chanda it is very common and is also found there on kunker soils. In Raipur it is rare, and has not yet been noted in Nagpur-Wardha, Bhandara or Bilaspur. It re-appears on the sandstones of the Pachmarhi hills (Northern Circle).

Sapindus laurifolius, *Vahl.* Ritha, *Mar.;* Kukur, Kunkuda, *Tel.*

The Soap-nut.

A large tree with even pinnate leaves and three pairs of opposite leaflets, pubescent beneath. Fr. 3-lobed, fleshy. Near villages, occasional. South Chanda (Donald).

NOTE ON THE CHIEF FODDER-GRASSES OF INDIAN FORESTS.

All valuable fodder-grasses are not necessarily important forest-grasses.

The fact is frequently overlooked that a grass, which is reported to be good for fodder, may be of no forest importance. There are, for instance, many well-known and valuable fodder grasses which, although common in fields, by road-sides and in village lands, are very rarely seen in large quantities in our forest grasslands. Such are, the well-known *dūb* (*Cynodon Dactylon*), several species of *Panicum Paspalum* and others, which cannot therefore be regarded as valuable forest-grasses.

Many important species are rare in forests.

Again, when growing in its natural habitat, a species may be only capable of producing a quite insignificant quantity of fodder per unit of area and is thus of little value compared with others which give a higher yield.

Species which give a high yield under cultivation may be of little value when growing wild.

The yield may of course be increased by cultivation, manuring and irrigation, but such treatment is not, as a rule, practicable in forest-grasslands and a species which is valuable on a grass farm may thus be of little forest importance.

Dūb, for instance, when growing wild, tends to spread along the ground and attains a height of only a few inches, whereas, when cultivated on manured or irrigated soil, it is reported to attain a height of 2½ feet and to yield as many as 10 crops annually with an outturn of 1,000 maunds per acre.* Thus, although *dūb* is a very common grass in the Dehra Dun district, the Supply and Transport Corps there depend for their fodder-supply almost entirely on the species *Andropogon monticola* which, besides giving a good yield per acre, also covers large areas in the local forests, and is undoubtedly the most important local forest fodder-grass. Finally there is the very important point of the distribution of the individuals of the various species to which very little attention has hitherto been paid. A grass, for instance, which is naturally sporadic and tends to occur in mixture with large quantities of other species is in itself of comparatively little value. The individual plants of such a species must either be cut separately, in which case the cost of collection tends to become excessive, unless the value of the species is altogether exceptional, or else the natural mixture of grasses must be cut *en masse* in which case the value of the fodder naturally depends on the quality of the most numerous species, and is, as a rule, little affected by the inclusion of a few scattered plants of any species, whether good or bad. There is little doubt that the collection and submission to a herbarium of isolated individuals of a grass with the note that it is "eaten by cattle" or "good for fodder" has in the past led to many records of "good fodder-grasses" which from the present point of view, must be regarded as practically worthless. From what has been said above, therefore, it will be realised that the study of forest-grasses is to a great extent a question *per se*, and that although a considerable quantity of literature exists regarding the value for fodder of indigenous Indian grasses, much of this is of no importance from the forest point of view.

Importance of a forest-grass depends greatly on the natural distribution of the individual plants.

* The *Farm Manual* by Major A. C. Williams and Major D. J. Meagher, Calcutta, 1903, p. 50.

Further study of forest-grasses urgently required.

Our knowledge of important forest-grasses is, in fact, at present, extremely scanty and the information available is quite inadequate for even an approximate assessment of the relative value of the different species, as regards :—

(1) their nutritive value,

(2) their yield per unit of area,

(3) the area occupied by them and their tendency to grow fairly pure or to form a considerable portion of the crop where they occur.

A systematic study of forest-grasslands is now being undertaken by the Forest Botanist at Dehra Dun, with the main object of determining (1) which forest species really are of greatest value ; (2) what are the conditions on which their healthy development and natural distribution chiefly depend. It is greatly to be hoped that local Forest Officers will find it possible to co-operate in this work as, without their aid, the collection of the necessary data and information must be long delayed. The point must, however, be strongly emphasized that in order to quickly realise the best results from this work, it is essential, in the first place, to concentrate attention chiefly on those species which tend to be dominant, or at all events to form a considerable percentage of the crop, over large areas. As a general rule (apart from a few species which yield products of quite exceptional value), such species are likely to be of the greatest economic value, whether regarded from the present point of view of fodder-yield, for paper-pulp, or other purposes. It is indeed probably not too much to say that the distribution of the various forest species is no less important than is the determination of their nutritive or other economic value, yet the information at present available under the first head is practically *nil.* Only when a study of the species has been completed, which must be regarded as most important from this point of view, should time be spent in the more detailed study of the grass flora of our forests. A beginning has recently been made with this work in the United Provinces where local Forest Officers are now preparing maps of

Attention at first to be concentrated chiefly on dominant species.

their principal grasslands and recording the names (scientific and vernacular), local economic uses, etc., of the grasses which constitute the principal portion of the crop in each. It is greatly to be desired that similar work should be carried out in other provinces.*

Tentative List of chief forest fodder-grasses given below.

A list of what are at present believed to be the chief forest fodder-grasses is given below. The species which have been included have been reported to be good for fodder and are believed to occur in considerable quantities in our forests. From what has been said above, however, it will be clear that in its present form this list is merely a tentative one which will undoubtedly require extensive alteration and correction as further information is obtained. Many of the vernacular names given have been merely copied from the publications noted below, and a considerable proportion of them will no doubt eventually prove to be incorrect. In the case of grasses particular care must be taken to verify the vernacular names, as many species are frequently confused with one another in the field and no name should be given as reliable, unless verified in different localities and by at least three different individuals. All names reported should be written in both English and vernacular, with a note as to the district in which they are used.

Information wanted for completion and correction of list.

Nutritive value of grasses.

Finally a few words regarding the vexed question of the relative nutritive value of grasses may not be out of place. No method of chemical analysis is at present known which can be depended on to correctly indicate the nutritive value of grasses, and reliable information on this point can only be obtained from systematic feeding experiments which have not as yet been carried out in India. For the present, therefore, the value of a grass in this respect must be judged by its local reputation and the extent to which it is actually used for

* The Forest Botanist will be glad to help local Forest Officers who may undertake this work and who wish to draw up lists of their important local grasses by identifying the specimens they may submit to him.

fodder. It is well, therefore, to bear the following facts in mind :—

(*a*) Where no first-class grasses are available the best which do grow well locally are largely utilised and highly valued accordingly, although, in more favoured localities, the same species may be considered of little importance. Attention, therefore, should be paid to the characteristics and general market value of the animals fed on different kinds of fodder in different localities, which is to some extent an index of the value of the local fodder.

(*b*) The value of a grass for fodder depends very largely on the season when it flowers. First-class fodder grasses are, as a general rule, most nutritious if cut when flowering. After flowering the culms dry up, become hard and contain little nutriment. As good hay cannot be made in the rains, those grasses which flower much before the close of the rains are of little use for hay, although they may be valuable for grazing, for green fodder, or for silage. In making local inquiries, therefore, care must be taken to draw a distinction between these various uses.

(*c*) The bad local reputation of a grass may depend on some individual characteristic which need not necessarily imply that it is of no value for fodder. Thus *Andropogon contortus*, although known to be a valuable and nutritious species if utilised before the barbed callus of the fruiting spikelets develops and hardens, frequently has a very bad local reputation on account of the injury done by the sharp-pointed "seeds" to the mouths of cattle and horses which are fed on the mature culms.

(*d*) There are many grasses which on deep moist soil become coarse with tall thick woody culms and large coarse leaves, whereas on shallow dry soil the

same species produce much smaller, more delicate culms and leaves which constitute a far superior fodder. Consequently one and the same species may produce fodder of far better quality in some localities than in others. This occurs for instance with the valuable species *Andropogon m onticola.*

A final decision as regards the best economic treatment to apply to our forest grasslands can only be arrived at when the study now initiated has been well advanced. In the meantime, however, there appear to be two principal directions in which it should be possible to considerably improve the present forest fodder-supply.

Improvement of forest fodder-supply.

The first of these consists in the prevention of excessive grazing by periodic closure or otherwise. Apart from the damage done to the grass plants themselves, which is considerable and which is naturally most severe in the case of the most valuable species, there is the no less important question of soil-deterioration. Heavy soil which is constantly trampled by cattle, especially in the rains, is more or less reduced to the condition of puddled clay into which water and air penetrate with great difficulty and move with extreme slowness. These conditions are, as a rule, very unfavourable for the development of the best grasses and in such areas comparatively valueless species, *e. g.*, *Eragrostis cynosuroides*, tend to become dominant.

Regulation of grazing.

Another way in which it should be possible to affect an improvement is in the treatment of some of the coarser species which are at present often little utilised. Although the mature culms of such species are too coarse to be of use for fodder, the young culms and leaves are usually relished by cattle. If the young culms also are cut back once, or possibly in some cases twice, during the growing season, a considerable quantity of good green fodder would become available in the rains which might be utilised as such, or converted into silage, while, at the close of the growing season, a crop of comparatively weakly culms and small leaves would be available capable of conversion into hay. In this way, also,

Utilisation of coarse species.

the accumulation of masses of dry coarse grass which greatly increase the danger of fire in the neighbouring forests would be prevented.

Publications referred to. The following are the principal publications which have been consulted in the preparation of the following list :—

Fodder Grasses of Northern India, by J. F. Duthie, Roorkee, 1888.

Grasses of the Southern Panjab, by W. Coldstream, London, 1889.

List of Bombay Grasses, by J. C. Lisboa, Bombay, 1896.

Flora of British India, Vol. VII, 1897.

Farm Manual, by Major A. C. Williams and Major D. J. Meagher, Calcutta, 1903.

Bengal Plants, by D. Prain, Calcutta, 1903.

Flora of Bombay, by T. Cooke, Vol. II, 1908.

Forest Flora of Chota Nagpur, by H. H. Haines, Calcutta, 1910.

Fodder Grasses of Berar, by D. O. Witt, Allahabad, 1911.

LIST OF CHIEF FODDER GRASSES.

(1) *Paspalum sanguinale* Lamk. (=*Digitaria sanguinalis* Scop.) Throughout India. Ascending to 6,000.'

Panjab bara takria (Hissar); dubra (N.-E.); mothi kabbal yaarakari.

United Provinces kewai (Bundelkhand, Aligarh); char-mara (Bijnor); siuri (Allahabad); kabdai (Pilibhit); sehri (Bhira).

Central Provinces korkol jodi (Seoni); chikhari (Berar); rai, rayar (Akola); sika (Betul); sailria, killa (Nimar); mandiya (Chanda),; rāha (Nagpur); sikka (Seoni, Balaghat).

Bombay fakri, fakria, kurad, suka roega, dinohi, chikari.

Bengal makur-jali.

Madras panapalu, shangali gadi.

(2) *Pennisetum cenchroides* Rich. W. India from Kashmir southwards.

Panjab kurkān, anjan, dhamman, dhaman.

United Provinces charwa (Aligarh); bandri (Allahabad); baiba, kusa (Banda).

Bombay jiral, anjan, dhaman.

(3) *Cenchrus biflorus*, Roxb. Chiefly N.-W. and W. India.

Panjab anjan, dhamman, dhaman.

United Provinces anjan.

Bombay anjan, dhaman.

(4) *Pollinia Cumingii*, Nees. Chiefly Upper Gangetic Plain.

United Provinces janewa (Bahraich); dheoria (Ramnagar).

Chota Nagpur lopud dumbu.

(5) *Ischæmum laxum*, Br. Chiefly Central and S. India; Burma.

Panjab sin.

United Provinces, sen.

Central Provinces, sira (Chanda); sedwa, (Balaghat); sainad, shahala (Berar); sairi, bara paonia (Nimar); sen (Jubbulpore).

Bombay gawan, suckal, sheda, pavna, pal paunat.

Madras coly pillu; neradi-gaddi *Tel.*

Bengal sen; raboga *Kol.*

Burma young bow myiaya.

(6) *Ischæmum sulcatum*, Hack. Central, W. and S. India.

Central Provinces pawana, paona (Akola, Yeotmal, Nimar); chota paonia (Nimar); sada, sainar (Melghat).

Bombay sheda, pavna.

(7) *Arthraxon lanceolatus*, Hochst. More or less throughout India, ascends to 8,000.′ Common in W. Himalaya 2,500—6,000.′ and often with *Anthistiria anathera.*

Central Provinces, nagri (Akola); dungad (Melghat).

Bombay, kadu marvel, marvel.

(8) *Apluda varia*, Hack. Throughout India and Burma, ascending to 8,000′.

Panjab, ganni (Lahore); santhran (Kangra); munmona (Patiala); murmuru (E).

United Provinces bhanjura (Allahabad, Etawah); bhanjuri, send (Banda); tach, tachula (Dehra, Haldwani); pala-khari (Haldwani); patpatawan (Bundelkhand).

Central Provinces gugar-gadi, kaltingiya (Chanda); bhus-jari (Seoni); polki (Akola); kadmor, gandhani (Yeotmal); phota, phula jara (Melghat); phulria, phuli, karmoria (Nimar).

Bombay phulse, tulsi, paodi, khavas, bhickma, kharwel, tambiti, tambat, chickwar, kurdia, gugar-gadi, pokilia, pockli, phulær, bhas, makkha.

Madras putstrangali, putsakangdi, pottichangali myel-kondai-pillu.

Bengal durhighas, goroma, gundha-gurana, chun khurki, tati, dhudhia sauri (Chota Nagpur).

Assam batua ban (Goalpara).

Burma young bow myetywapya.

(9) *Andropogon foveolatus*, Del. Drier parts of India.

Panjab ghirji.

United Provinces murjhaini (Etawah); girgua (Jhansi); murjnah, mujna (Lalitpur).

Central Provinces lokhandi (Akola, Yeotmal); silkia marwel (Yeotmal); gandhila (Nimar).

Bombay karwat (Panch Mahals); ghandel, marwel, boari, kard.

(10) *Andropogon pumilus*, Roxb. (= *A. pachyarthrus*, Hack). Drier parts of India.

United Provinces gangerua (Bundelkhand).

Central Provinces mālakaya (Nagpur); mālka-phalka (Chanda); lal gondali, lahan masrut (Akola); ghon-dhani, bhurbusi (Yeotmal); tagargoti (Nimar).

Bombay baerki, gondval, lal-gavat, tambrut, gondad, chiman, chira, malakava.

(11) *Andropogon Ischæmum*, Linn. N.-W. India ascending to 12,000′.

Panjab palwan.

United Provinces jarga (Aligarh, Muttra); janewa (Allahabad).

(12) *Andropogon pertusus*, Willd. Drier parts of India and Burma.

Panjab palwan, girji.

United Provinces, sandhur (Gonda); phulra, phulaira, tikria (Bundelkhand); janewa (Allahabad); rukah (Banda).

Central Provinces chota piya, vida-gucha gadi (Chanda); gohhaya (Nagpur); malhar (Balaghat); killa (Berar); malher (Akola); makhel (Nimar).

Bombay ganya marvel (Satara, Sholapur); payen, palva, palwan.

Madras sewam pilla.

Bengal kada chandi, maliyar.

Burma myetspodown mare.

(13) *Andropogon lancearius*, Hook f. Chiefly Sikkim and Chota Nagpur.

Chota Nagpur korpo dumbu.

(14) *Andropogon monticola*, Schult. More or less throughout India ascending to 6,000′; Burma.

Panjab dhaulian, khar.

United Provinces gurla, gorha (Dehra); goria, guria (Ramnagar, Haldwani); ghatera (Gonda); dhaulu (Dehra).

Central Provinces palla paggar gadi (Chanda); jhingra-ka-jhara, khidi (Berar); gogad (Akola); Sani khidi (Melghat); phulkia (Nimar).

Bombay gogar, ghora, agiva, dand.

(15) *A. caricosus*, Linn. India from Gangetic Plain southwards; Burma.

United Provinces kail, kheral (Bundelkhand).

Central Provinces palmanega gadi (Chanda); bilaria kandi (Seoni); killa machhar (Berar); motha marwel' bari kail (Nimar).

Bombay telia, jetara, chaoria, patang, marwel, ganya marwel.

Bengal detara, detta.

(16) *A. annulatus*, Forsk. Throughout India.

Panjab palwan.

United Provinces jaunera (Gorakhpur); nalli (Mainpuri); nilon (Aligarh); janewar (Allahabad); jarga (Etawah); palmaha (Dehra); phulaira, khel (Lalitpur); donda (Banda).

Central Provinces māliyar (Chanda); belia marwel, (Akola); guhar marwel (Yeotmal); machhari (Melghat); kail (Melghat, Nimar).

Bombay jinjwa (Panch Mahals); marvel, sheda, sam, payen, palwan.

Madras sewam pilla.

Bengal loari, maliyar.

(17) *Andropogon contortus*, Linn. Throughout India. Ascending to 5,000′; Burma.

Panjab sarwāla, sarari, sarala, sariala.

United Provinces kumriya, kumariya (Dehra, Ramnagar, Haldwani); sarwāla (Dehra, Pilibhit); parwa, parba, parwaya, lampa (Bundelkhand); sura (Gonda); shora (Bahraich).

Central Provinces kusli (Akola, Yeotmal); ponia jara, butu jara, saga jara, sona jara (Melghat); sukal, lampa (Betul); sukli (Nimar); kusal, hukara gadi (Chanda); kusal (Balaghat); pochati, saga (Berar) parwaya, lampa (Jubbulpore).

Bombay sukhli, kussal (Panch Mahals); kursali.

Madras sharpul.

Bengal Kher.

Chota Nagpur sauri, saiyu, chorant.

Burma youg myayi.

(18) *Anthistiria imberbis*, Retz. Drier parts of India, ascending to 10,000′; Burma.

Bombay batani, bunden, bungrat, morar, musani, bhoru, karad; but many vernacular names used for the next species probably also apply to this in Bombay and elsewhere.

(19) *Anthistiria ciliata*, Linn. (including *A. scandens*, Roxb.) More or less throughout India, ascending to 7,500′; Burma.

Panjab ghandi.

United Provinces guner, ganaiya, ganori (Bundelkhand); bhoru (Allahabad).

Central Provinces guner, bhonr (Jubbulpore); ghonyar, era-kolla-gadi (Chanda); ghonadi, ghonal (Nagpur); guner (Balaghat); chudur jahara (Seoni); gondalli (Berar); ghonad, motha bondel (Yeotmal); gondali, gud sukud (Melghat); gondar (Betul); guniar, gondal (Nimar).

Bombay bhathi (Panch Mahals); biggodah, gondial.

Madras guner, ramalchipillan.

Bengal titar, gandhel.

Burma myet ye gei.

(20) *Anthistiria tremula*, Nees. Central and S. India.

Bombay bungrat (Poona); bhatandi, barki, gundi.

(21) *A. Cymbaria*, Roxb. W. India.

Bombay Karar, ful-gavat.

(22) *A. anathera*, Nees. W. Himalaya, ascending to 9,000′.

Panjab kohdi.

(23) *Iseilema Wightii*, Anderss. Throughout India.

Panjab ganni (Gujranwala, Shahpur, Lahore).

United Provinces okar (Bundelkhand); gandel (Aligarh).

Central Provinces ukri (Jubbulpore and Saugor); mushad (Yeotmal); ghania (Nimar); ghod-mushan (Hindi, Chanda); pulchumalwa-gaddi (Tel. Chanda); puair (Marathi, Chanda); malwa-gaddi (Gondi, Chanda).

Bombay gandheli (Panch Mahals); sona, tambrut, tambit, gondwal, ganni, mussan.

(24) *Iseilema laxum*, Hack. More or less throughout India.

Panjab gāndi (Hissar); chhat (Rawal Pindi); luinji (Kangra); champ (Simla).

United Provinces machaori, musel (Bundelkhand).

Central Provinces musel (Jubbulpore); mushan (Marathi, Chanda); manchi-malwa (Tel. Chanda); *tikha-lodan*, gonda (Nagpur); ghorayal (Seoni); masuri, musel (Nimar).

Bombay shata, gandwel, tambit, tambrut, gandhi, masel.
Madras pinashrappa.

(25) *Pseudanthistiria hispida*, Hook f. Chiefly Central and W. India.
Central Provinces gandeli, dangli (Nimar); chota guner.
Bombay pokalya.

R. S. HOLE,
Forest Botanist.

EUCALYPTUS IN NORTH-WEST INDIA.

Eucalyptus appear to have first been introduced into North-West India in 1860 and since then numerous species have been tried. Unfortunately owing to the records of the trials which have been made, being incomplete, the experiments afford little information as to the species which will thrive. Annual Forest Administration Reports of the Punjab Circle and of the various divisions in the Punjab, as well as the Annual Reports of the Government Agri-Horticultural Gardens, Lahore, and Botanic Gardens, Saharanpur, and miscellaneous publications contain a great deal of information as to the species tried, but the information is mainly of negative value, as the plants referred to are seldom more than a year or two old and many species with sufficient care can be got to live for a few years in pots, though they soon die off when planted out exposed to the sun and hot winds.

At the present time considerable attention is being devoted to Eucalyptus in the Punjab and elsewhere, and the object of the present note is to show the results of the experiments made with the genus hitherto. Last year some 12,000 Eucalyptus plants were distributed from the Government Agri-Horticultural Gardens, Lahore, alone, and this year it seems probable that this figure will be exceeded. After excluding synonyms and species tried under names which I have not been able to trace in works on the Genus, it appears that about 100 different species of Eucalyptus have

been tried in North-West India. In many cases the seed was doubtless not true to name, which is by no means unusual with Eucalyptus seed, whether procured from Europe or Australia, and for this reason a single trial is unreliable, unless the seedlings can be inspected and compared with an authoritative description. When many kinds of Eucalyptus are being tried at one time, it is very difficult to prevent a few seeds from getting into the wrong seed-pots and this will account for a large batch of seedlings dying with the exception of one or two individuals which may grow vigorously if they happen to belong to a suitable species. I have seen several instances of this and the reports on trials made in the past show many suspiciously similar cases which have to be discounted accordingly. The fact that a species has been tried once or twice without success does not necessarily show anything with regard to the species tried, though it may give one an insight into the manner in which the trial was made. For instance, experiments with the seed of several species have been made at one time and have resulted in complete failure, though one or more of the species tried would certainly have grown with ordinary care. Most of the older reports on *E. resinifera* and *saligna* appear to refer to quite different species.

After making allowances for the sources of error mentioned above, it seems evident that the following species have been sufficiently tried to show (as in most cases the natural habitat of the species would have led one to suppose) that they are quite unsuitable for planting on the plains:—

E. amygdalina, *Labill.*
E. capitellata, *Sm.*
E. coccifera, *Hook. f.*
E. coriacea, *A. Cunn.* (-E. pauciflora, *Sieb.*)
E. corymbosa, *Sm.*
E. Globulus, *L'Herit.*
E. goniocalyx, *F. v. M.*
E. Gunnii, Hook f.
E. haemastoma, *Sm.*
E. macrorrhyncha, *F. v. M.*
E. marginata, *Sm.*
E. obliqua, *L'Herit.*
E. pilularis, *Sm.*
E. piperita, *Sm.*
E. resinifera, *Sm.*
E. Sieberiana, *F. v. M.*
E. Stuartiana, *F. v. M.*
E. urnigera, *Hook f.*
E. viminalis, *Labill.*
E. virgata, *Sieb.* (-E. stricta, *Sieb.*-E. obtusiflora, *DC.*)

The following species appear to be unlikely to thrive in the plains though the evidence is not as yet conclusive :—

E. acmenoides, *Schau.*
E. alpina, *Lindl.*
E. Andrewsii, *Maiden.*
E. Baileyana, *F. v. M.*
E. calophylla, *R. Br.*
E. cinerea, *F. v. M.*
E. corynocalyx, *F. v. M.*
E. delegatensis, *R. T. Baker.*
E. dives, *Schau.*
E. eugenioides, *Sieb.*
E. eximia, *Schau.*
E. ficifolia, *F. v. M.*
E. Luehmanniana, *F. v. M.*
E. longifolia, *Link. and Otto.*
E. Macarthuri, *Deane and Maiden.*
E. macrandra, *F. v. M.*
E. macrocarpa, *Hook.*
E. microcorys, *F. v. M.*
E. Muelleriana, *Howett.*
E. occidentalis, *Endl.*
E. obcordata, *Turcz*, (-E. platypus, *Hook.*)
E. Planchoniana, *F. v. M.*
E. regnans, *F. v. M.*
E. rubida, *Deane and Maiden.*
E. Smithii, *R. T. Baker.*
E. stellulata, *Sieb.*
E. trachyphloia, *F. v. M.*
E. umbra, *R. T. Baker.*

The records of the experiments made hitherto with Eucalyptus afford practically no information as to the species suitable for the plains as the reports rarely refer to plants more than a year or two old and several species, notably *E. Globulus* will thrive for a time though the first really heavy downpour of the monsoon usually finishes them. Consequently it is necessary to identify trees found growing and flourishing, the names under which they were introduced having long since been lost and sometimes replaced by others which are incorrect. Owing to the large number of species of Eucalyptus and the variability displayed by different individuals of the same species and the similarity in one or more characters of different species, it is usually necessary to have very complete specimens showing leaves, both of mature trees and of seedlings, flower-buds, flowers and ripe fruits. Such specimens can seldom be obtained without several visits to the specimen tree, and this it is not always practicable to make. Below are mentioned all the species which I have been able to identify with tolerable certainty, but it is not intended to be a complete list of all the species at present growing in the plains. It can safely be said, however, that at least 9 out of 10 of all the Eucalypti in the plains of the Punjab belong

to one or other of the first three kinds, excluding plants put out during the last two years.

E. maculata, Hook, var. *citriodora*.—This species is easily recognized by the scent of the leaves, and is always grown under the name *E. citriodora*. It is the species most often seen in Saharanpur and Dehra Dun, but in the Punjab it is less common than the two following. In Lahore it is not very easy to raise from seed, the plants making very little growth for the first two years and dying off in numbers during the first monsoon. Once established the growth in height is fast, but it does not seem to reach a large girth, I have never seen one as much as 5 feet in girth.

E. tereticornis, Sm.—This and the one following are the commonest species in the Punjab and have given the best results at all places where extensive trials with Eucalypti have been made, that is to say, in Lahore, Changa-Manga, Amritsar and Kapurthala. In Kapurthala there are extensive plantations of Eucalyptus consisting mainly of this species. In Saharanpur and Dehra Dun it is seldom seen. It reaches a girth of 10 feet and more and a height of over 100 feet.

E. rostrata, Schl.—This species has been quite as successful as *tereticornis* being perhaps rather better for dry places, but otherwise not quite so straight-boled and free from large branches as the latter. It is seldom seen in Rawalpindi and Hazara Districts where *E. tereticornis* is almost the only species grown, but further east it is usually more frequent than the latter. *E. rostrata* and *tereticornis* have for many years been distributed from the Agri-Horticultural Gardens, Lahore, under the name *E. resinifera*.

E. crebra, F. v. M.—This species is seen occasionally in Lahore, Amritsar, Kapurthala, Changa-Manga and Saharanpur. It is rather variable in habit, the stem being sometimes clean and at others covered to the base with thin switchy shoots. When young the growth is slow for Eucalyptus, both as regards height and diameter. The best specimen in Amritsar is about 7 feet 6 inches girth and 100 feet high.

E. melanophloia, F. v. M.—This species is grown in Lahore, Changa-Manga, Agra and Saharanpur. In Saharanpur it is known

as *E. melliodora* by the malis in the Botanic Gardens. When young it is apt to grow spindly and requires staking, given sufficient water the growth is fairly fast, but at the same time it stands drought well.

E. saligna, Sm.—This species I have only seen in Amritsar where there are a number of specimens growing remarkably well. Seedlings sown in Lahore last spring died off in large numbers during the monsoon, but the survivors are now quite healthy and vigorous. (It may be mentioned here that there is a tree in Saharanpur known as *E. saligna*, though it is not that species.) It is also grown in Lahore and in many respects including its demands on moisture in the soil, resembles *E. robusta* ; this tree is perhaps *E. kirtoniana*, F. v. M.

E. robusta, Sm.—This is occasionally grown in Lahore, Kapurthala, Saharanpur and Agra. Young plants are vigorous and ornamental if well watered, but older specimens are usually misshapen and ugly. The only good specimen I have seen was one growing in a swamp at Kapurthala fully 80 feet in height with a straight clean stem. In Australia it is called the 'Swamp Mahogany,' and it evidently requires a great deal of moisture for satisfactory growth. I have seen young plants in Lahore growing in ground which remains wet throughout the year and for such places it is worth growing but it should not be tried in even moderately dry situations.

E. siderophloia, Benth.—I have only identified one specimen of this species, and it is in Changa-Manga and is doing well.

E. sideroxylon, A. Cunn.—This species is evidently the one referred to in Brandis' 'Indian Trees' under '*E. Leucoxylon*, F Muell. *Iron Bark*.' There are several specimens in Changa-Manga about 4 ft. 6 in. girth and 60 ft. in height. All have crooked stems and a good deal of dead wood in the crown. They appear to require more water than they get at Changa-Manga and perhaps a cooler climate.

The foregoing remarks apply to the Plains and Sub-Himalayan tract, in the hills the only place I have seen where Eucalypti have been extensively grown is Abbottabad, though an occasional

specimen may be found at other places up to the winter snow-line, above which the kinds tried hitherto suffer from snow-break. The species seen are *E. tereticornis, rostrata, sideroxylon, maculata* var. *citriodora* and *Globulus*. Prior to the exceptionally heavy frost in 1905 *E. Globulus* was far commoner in Abbottabad than it is now, and was probably the species most frequently grown in the station, now there is not a specimen that has not been badly injured and large numbers had to be felled, having been killed outright. At the present time *E. tereticornis* is by far the commonest species in Abbottabad, though it too suffered from frost in 1905 though not to the same extent as *E. Globulus* and many large trees escaped practically uninjured. There are several specimens of *E. sideroxylon* in Abbottabad, all more or less injured by frost, not to the same extent as *E. Globulus* though considerably more so than *E. tereticornis*. Omitting an exceptional year, such as 1905, in which many of the trees indigenous in Hazara suffered quite as much as Eucalypti, it is evident that *E. sideroxylon* does better at 4,000 ft. than it does in Changa-Manga. Of *E. rostrata* and *maculata* var. *citriodora*, I only found one specimen each, which dated from before 1905. The latter was known to be sensitive to frost and was protected by having straw tied round the stem, but in spite of this it was very badly injured. *E. rostrata* appears to be as hardy against frost as *tereticornis* judging from the single specimen. As a great many species of Eucalyptus are now being tried in the Government Agri-Horticultural Gardens, Lahore, the Simla Hills and elsewhere, it should be possible in a few years to add considerably to the information at present available.

LAHORE : R. N. PARKER,
12*th November* 1912. *Deputy Conservator of Forests.*

LIONS IN BRITISH EAST AFRICA.

A correspondent sends us the following account of how his son, who is employed on railway construction in British East Africa, shot his first lion. The lions are proving a great nuisance and greatly hinder the construction of the railway which is being made to tap the Magaddi-Soda Lake—they have already killed several men, coming into the camps and causing panic amongst the coolies. The narrative shows the risk and difficulty of destroying them. There are practically no trees, and the secure haven of a "Machan" is unattainable.

The young man writes :—

"This is an account of how I shot my first lion.

Three nights ago there were a number of lions round my camp but as there was a high wind and the tents were flapping so, we could not tell what they were doing and so did not trouble about them.

The next morning we found that one of our horses had been killed and half-eaten by lions, the horse was in a "Boma" with another one and three mules which stampeded had returned next morning.

Well, as a rule, lions always come back to their "kill" next night, so we did not touch anything and waited for them. I heard them at 6 o'clock p.m. that evening roaring in the distance which was not a good sign.

However, about 7-30 P.M., just as we were going to start dinner, I heard them eating the horse, which, by the way, was not 100 yards away from our tents.

There was another man with me and we went out with our rifles and lamps.

It was pitch dark, so we went slowly, the result being that the lions did not run away, but stood growling at us. When we were about 20 yards of from the "kill," I could see their eyes shining, at the same time my pal saw them, with the result that we both fired, then the fun started.

By some stroke of luck we both hit a different lion ; anyhow two stopped and the others, (four we found out afterwards), cleared off.

The one my pal shot at tried to get off, but mine was only hit slightly and he came for me.

By this time he was only 14 or 15 yards off, and I could see him fairly plainly, as I had my boy standing behind me with a lamp.

I was kneeling down on one knee so as to get a good shot, and I got him right in the chest, with the result he reared up on his hind legs ; while he was like that my pal hit him again, his lion having slunk off.

Then my lion crawled off down the hill, and as I was following him up I noticed that my pal (who is very deaf) was also going after his, and I saw that very soon we would have the lions between us and start shooting each other, so I gave up mine and helped him. We found him about 50 yards away and after a little excitement finished him off; he had six holes in him.

While we were admiring it, all the white men and natives in the camps round came up and between them they had about ten rifles, mostly in the hands of natives.

Well, we then went after mine and found it quite near, and as I was in front taking some sort of aim there was a volley from behind me which nearly deafened and blinded me, the devils would not come up close, but were firing from about 5 yards behind me all over the shop where they heard the lion growling.

For a few seconds we both forgot the lion and went for these d—d natives, and after knocking a few down we killed the lion, we had four shots in him, the volley having missed him.

After they were both dead the natives had a sort of war dance and kicked up such a row that we had to stop them because we wanted to get the other lions and expected them back any moment.

We carried the two beasts into a hut and set a trap I had, in case any thing should come back.

The trap is a huge gin, like a very large rabbit-trap, and I put it just by the dead horse. We then went to bed.

The whole night the other lions were walking round and round our camp. Three white men were so frightened that they slept up a tree, I am ashamed to say.

Well, at 1 o'clock A.M. one of the lions got into the trap and kicked up a frightful row. So out we went again and had perhaps more fun than before, as we were alone except for four boys with lamps.

When we got near, the brute began jumping about all over the shop, first out of the "Boma," then back again, then trying to charge and then ran away again, but as he could not go very fast (quite fast enough), we enjoyed it.

At last he came too near and we saw him fairly well, so both *fired, he then jumped back into the "Boma" and we could not* hear a sound, we crept up to about 10 yards from where he was and did not like to go any further, as we did not know if he was dead or if he was waiting for us.

At last one of our boys said he would go and find out; we told him not to, but he took no notice, so I gave him my gun and he went off alone with a lamp; he went straight up to where the lion had gone and must have been within two yards of him when the wind nearly put his lamp out, so he deliberately turned his back on the lion and put it right, he then turned round again and found the beast lying dead 1½ yards off.

If the lion had been alive he would have been killed to a certainty. He had no fear of any sort.

So ended the most exciting time I have ever had.

My lion was 10′ and the two lionesses 9′ 6″ each, but although they were small they are quite good enough."

SYLVICULTURE IN THE TROPICS.*

There are few writers more competent to produce a work with the above title than the author of the book in question, whose experience of forest work in the tropics extends to India, Ceylon and the Sudan. The book is divided into four parts:—(I) Factors governing and influencing the Existence of Forests ; (II) Formation and Regeneration of Forests ; (III) Training and Improvement of Forest Crops ; (IV) Special Measures of Maintenance and Improvement.

Part I deals mainly with soils, climate and locality, and the various animal and other agencies which affect forests. The author draws freely on his own experience in dealing with these wide subjects, and the majority of the examples given are naturally confined to those tropical regions with which he has had personal acquaintance ; in dealing with other regions, such as tropical America and Africa, other writers are quoted, Schimper's well-known *Plant Geography* being frequently referred to. The question of soils is a vexed one, but the author has, we think, come to the correct conclusion, namely, that, as far as our knowledge goes, the physical properties of the soil are of more importance in Forestry than its mere chemical composition. The study of bacteriology, when further advanced, may yet lead to important discoveries relative to forest soils, but here again the physical properties of the latter, and particularly the degree to which aeration is effected, must necessarily have a vital influence on the activity of the bacteria. In commenting on the absence of humus in many tropical forest soils, and particularly in evergreen forests, the author suggests as the causes the comparatively gradual leaf-fall in such forests, the rapid decomposition which goes on in tropical climates and the torrential rainfall: it is also, we think, generally accepted that one of the chief causes of the rapid disappearance of fallen leaves in tropical forests is the presence of termites.

The phenomenon of "twisted fibre" in trees is touched upon, but the conclusion that it is necessarily caused by the action of the

* *Sylviculture in the Tropics*, by A. F. Broun, Macmillan & Co., Ltd., London, 1912 pp. XVIII, 309. Illus. 96.

wind is, according to our own observations, not borne out by actual facts; for although wind may very possibly be a factor in producing twisted fibre, it seems fairly certain that the causes of it are in reality more complex than we are given to suppose. We are also unaware that the "spike" disease of sandal has, as stated on page 64, been definitely identified as a root-parasite which destroys the haustoria through which the sandal tree obtains nourishment from its hosts. A broad view is taken of the effects of fire-protection in the tropics, for while instancing its great benefits in the majority of cases, the author cites the now well-known instance of its adverse effects in certain types of teak forest in Burma, in preventing the reproduction of teak. We do not quite follow him, however, in his statement at the foot of the page 87 that the abandonment of fire-protection in those sál forests of Assam which appear to suffer in the same way from continuous protection will necessarily have the effect of destroying the delicate sál seed. For whereas the teak seed, guarded by its felty covering, lies on the ground throughout the greater part of the fire-season, the sál seed does not fall until the monsoon is nearly ready to burst, or until it has burst, while if by some mischance the seed has to lie on the ground for some time before the rains break, it is almost certainly doomed to perish from drought: the question of fire, therefore, would hardly come in.

Part I makes interesting reading, and the reader will find it a useful introduction to the study of what is a vast but none the less fascinating subject.

Part II treats of the formation and regeneration of forests. Artificial regeneration, including nursery management and sowing and planting, is clearly and concisely dealt with. It is when we come to natural regeneration that our chief difficulties begin. These difficulties are fully realised by the author, who has to fall back on European experience in dealing with the various sylvicultural systems, for in the tropics, although a certain amount of progress has been made in the employment of coppice systems, there is very little to show in the way of high forest systems of management other than improvement and selection fellings. A

brief description of some of the salient points relating to more scientific systems as evolved in Europe is, however, rightly included by way of guidance as to the lines on which improvement in sylvicultural systems may be directed in the tropics. While fully recognising the difficulty of dealing with sylvicultural systems which have never been attempted in the tropics, there appear to be one or two points regarding which the reader might desire further enlightenment. For example, under clear-fellings there is included a system termed the "well method," which is described as consisting of a number of a small clearings about half acre in extent made here and there all over the forest: regarding the subsequent regeneration of the forest as a whole, however, we are left in the dark; it would perhaps have tended further to make matters clearer if the precise difference between this system and the group system had been explained.

The difficult subject of artificial regeneration substituted for or combined with natural regeneration is briefly dealt with in Chapter IX of Part II. This chapter contains the statement that the dibbling of teak seed in the selection-worked teak forests of Burma is strongly advocated; we believe we are right in saying, however, that this method of regenerating teak in Burma has rarely, if ever, justified itself, having in the great majority of cases resulted in failure. The Burma *taungya* system is also not quite accurately described, since the usual custom is for the *taungya* to be kept under crops for one season only and not for some years as stated.

Part III deals with an important branch of the tropical Forester's work, namely, the execution of cleanings, thinnings and improvement fellings, and Part IV contains a description of the principal special measures of maintenance and protection, namely, demarcation, fire-protection and the fixation of unstable soils. The chapter on fire-protection contains a clear and concise account of the chief measures adopted in the tropics for guarding against damage by fire, and contains many useful hints.

The book is well printed and the diagrams are good and clear; some of the photographic reproductions, however, are somewhat

wanting in clearness. In common with other writers, the author has unfortunately succumbed in certain cases to the temptation of adopting new expressions for well-known terms to which we have become accustomed; perhaps the most flagrant example of this is the use of the term "shade-avoider" for the more usual and distinctly more euphonious term "light-demander".

The book is both interesting and instructive, and the forester in the tropic will find in it many good practical hints to guide him through the various shoals which beset his path: it is well worth study not only by the young forester about to commence his career in the tropics, but also by men of more mature experience.

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THE CULTIVATION OF DRUGS IN INDIAN FORESTS.

The question of the cultivation of drugs in the British dominions has recently formed a subject of a very interesting discussion at a special meeting of the Chemical section of the London Chamber of Commerce. The object of the meeting was to consider the nature of the evidence which it was desirable to bring before the Royal Commission, which has been appointed to enquire into and report upon the natural resources of the Dominions of Canada, the Commonwealth of Australia, the Dominions of New Zealand, the Union of South Africa and the Colony of Newfoundland. Mr. J. C. Umney, the President of the British Pharmaceutical Conference, in his address said that the meeting was the direct outcome of the Presidential address of Sir Edward Evans in the British Pharmaceutical Conference held in Edinburgh at the end of July, who had brought his wide experience of business to bear upon a subject which is of the very greatest importance to the Empire. Having travelled through Canada and the United States comparatively recently, Sir Edward Evans was able to see what advance had been made, more especially in the United

States, by the establishment of a Bureau of Plant Industry under the Board of Agriculture, where all questions relating to the development of drug cultivation are considered. There could be no question that the work which had been done in the United States in connection with plant cultivation was of the highest importance, and this was evident from the publications that are printed from time to time such as that recently issued on the cultivation of *Hydrastis*. Mr. Umney then went on to say that the broad views expressed by Sir E. Evans were further elaborated by *Mr. J. Herbert Evans* who gave the details of the possibilities of extension of the cultivation of drugs, etc., a quotation from whose paper is given below, and instances were quoted by him showing where plants indigenous in one country and originally marketted from one country only had been introduced into the other countries and established on a very firm foundation. Mr. Herbert Evans referring to the fact that the British Empire embraced practically every variety of climate and situation and looking to the means of transport at the disposal of this vast Empire, and also to the Scientific Knowledge, at their disposal advocated strongly that the subject of the cultivation of the drugs in the Empire should be developed. Mr. Umney combined his proposal for the cultivation of the plants for the distillation of perfumes and essential oils with that of cultivating drugs.

Having read of such attempts as these being made in England for bringing the subject of cultivation of drugs into prominence, I have been encouraged to bring forward a few ideas that I have been entertaining for some time past on the cultivation of medicinal drugs in this country, which, broadly speaking, may be said to be an epitome of the climates, seasons and soils of the whole British Empire.

Most of the drugs prescribed in the British Pharmacopæia grow wild in India and there is already a large export trade in some of them. But the materials collected at random cannot be expected to fetch their full price, as they seldom come up to the standard quality. A few drugs that are not indigenous to India could easily be made to grow in some parts or the other of this vast

land. The great advantage accruing from the systematic cultivation of drugs is that a regular supply of genuine drugs of a standard quality is assured. The variation in the quality of wildgrown drugs is sometimes a very serious drawback to finding a profitable market for them. The quality of the *Podophyllum Emodi* growing wild in India is an illustration in point. This plant was discovered by Sir George Watt in the year 1888 and now even after twenty-four years in which it has been shown to be identical with the American drug that is being employed for Pharmaceutical purposes, it still remains unrecognised by the British Pharmacopœia, which, as explained by the "Chemist and Druggist" of London some time ago, is solely due to the uncertainty that still exists as to its physiological activity. This uncertainty can only be reduced to a minimum by artificially cultivating the plant under uniform conditions and collecting it at the proper season. In this connection, I would make a quotation from Mr. J. H. E. Evans' paper on "Suggestions for the more extended cultivation of drugs" published in this year's 7th August issue of the "Chemist and Druggist," London, in which he sums up his position on this subject.

Mr. Evans says :—"Government Departments in the United "States of America, Germany, and elsewhere foster the cultivation "of drugs, but what advancement is made in this country (England) "is almost entirely the result of private enterprise. The facts to "which attention is drawn are:—

(1) "That the present sources of supply of food vegetable drugs "are, in quantity and quality, restricted in area, and thus dependant "on forces, which cannot be controlled, such as (*a*) weather, (*b*) "time and method of collection, (*c*) labour available, (*d*) careless "methods of preparing for market, leading to sophistication.

(2) (*a*) "That the influence of such natural causes might often, "both as regards quality and quantity, be controlled by systematic "cultivation, (*b*) but that such cultivation must be scientific and "organised.

(3) "Some of the conditions to be observed in such cultiva-"tion.

(4) "That it should be possible to cultivate much of our "vegetable materia medica in the British Colonies.

(5) "That improved methods of transport encourage this "object.

(6) "That the introduction of synthetic bodies is not neces- "sarily a discouragement to such cultivation of natural products.

(7) "That there are inducements for such cultivation politi- "cally and technically.

"Weather is an important factor. Two years ago a wet "season caused an almost entire failure of several Englishgrown "root crops, notably valerian. An exceptionally dry season limits "the crop of such herbs as lavender, rosemary, etc. Heavy winds "and late frosts may ruin whole crops in a few hours. The same "causes are at work abroad, often even to a greater degree ; for, "although dry and wet periods can be more accurately foretold, "when the unexpected happens the damage caused is much greater. "Typical examples are the loss of the lemoncrop of 1900, owing to "the high winds prevailing during the blossoming period and still "more terrible devastation by the recent earthquake in Sicily. The "unpropitious weather will reduce the Bulgarian rose crop by one- "half. In the Island of Montserrat some twelve years ago a hurri- "cane destroyed the limefruit plantations and temporarily stopped "the production of papain and arrowroot. The appearance of crops "must be influenced by the weather conditions existing at the time "of ripening and collection. Where active principles can be "estimated, physical appearance is not necessarily a criterion of the "medicinal value of drugs. On the other hand, few experts would "rely upon a damaged parcel of ergot. The main object of the "cultivator is to obtain the greatest possible quantity of material in "the shortest possible time, while the chemist wants the best mate- "rial at the lowest price. With drugs valued on the proportion of "active principle they contain the collector naturally follows the "demands of the chemist, guarding against wide fluctuations by "analysis or experience. For instance, *santonica* yields much more "santonin in July than in September, aconite is more potent towards "September than earlier in the year, belladonna from old plants is

"poorer in quality, weight for weight, than when collected from "younger plants, and young cinchona trees contain comparatively "a small proportion of quinine. It is open to question whether the "practice of valuing drugs according to a recognised active principle "is correct, and while this valuation is the most definite safeguard "possessed at present, it is interesting to speculate whether condi-"tions of climate and collection may not affect also the more complex "and unknown bodies present in drugs. The quality and quantity "of raw material which can be judged has improved without a "corresponding increase in price, doubtless due to manufacturers "insisting on material of a reasonable standard being supplied. "Belladonna containing over ·5 per cent. of alkaloid is now in satis-"factory supply, whereas a few years ago it was difficult to get "roots of half this strength. Formerly it was commonly said that "the standard for resin in jalap was too high, but a drug well over "the B. P. limit is readily obtainable at present."

Further on he says : "In considering a remedy for uncertain "supplies of drugs, such as more extended systematic and controlled "cultivation, the production of material of suitable quality, as well "as extension of area cultivated, must be borne in mind. Conium "and aconite are less poisonous, even in the wild state, the further "north they grow. Cultivation in some cases apparently prevents "production of alkaloids in plants, but with cinchona selection has "given a strain richer in active principle than the wild plant.

"The following are a few products at present cultivated more "or less successfully :—

"Calumba in Ceylon; eucalyptus and patchouli in the Tropics; "belladonna in England, France and America ; cocoa in the West "Indies, Ceylon and Zanzibar ; kola-nut in the tropics generally ; "cinnamon in Ceylon ; ginger in Japan ; turmeric in the tropics ; "ipecacuanha in India, and to some extent in Brazil ; valerian in "England, Germany and Austria ; manna in Sicily ; benzoin in the "Straits Settlements ; opium in the East ; and many plants like "peppermint, lavender, etc., in England.

"The results achieved in agriculture and horticulture lead one "to suppose that similar benefits would follow the efficient cultiva-"tion of drugs."

In this connection a few more examples may well be cited here. Mr. David Hooper in his "Notes on Indian drugs," published in the "*Pharmaceutical Journal and Pharmacist*" of 28th September 1912, gives a very interesting account of the cultivated belladonna and saffron. The roots of the belladonna plant growing wild in Kashmir gave 0·45 per cent. of alkaloid, while the two specimens of belladonna roots, one from a plant one year old and the other from a plant two years old, cultivated at Jeolikote by the Superintendent of the Kumaun Government Gardens gave 0·4 and 0·45 per cent. of alkaloid respectively. The European roots give from 0·2 to 0·6 per cent. of alkaloid. This indicates that the cultivation of *Atropa Belladonna* in India can give roots of average medicinal value. As remarked by Mr. Evans quoted above, it is possible to increase the alkaloidal content of drugs by a thorough scientific cultivation.

The stigmas of *Crocus sativus* or saffron experimentally cultivated at Quetta have been reported by Mr. Hooper to be of excellent quality.

In my humble opinion, I think it very desirable to extend the work proposed by the British Pharmaceutical Conference to India so that the cultivation of the Pharmacopœial and other drugs may open new fields of plantation industries which as, remarked by Mr. Evans, are in no danger of being run down by the synthetic products.

In addition to the cultivation of the Pharmacopœial drugs about which as regards their chemistry and cultivation, much is already known, I beg to propose for your consideration a thorough investigation into the medicinal drugs used by the Indian systems of medicine.

The Indian systems of medicine mostly depend upon the herbs and drugs growing wild in the forest and the number of the drugs employed by them is a very large one. Comparatively speaking the British Pharmacopœia has recognised a very limited number of drugs till now, but the native druggist could count offhand hundreds of vegetable drugs that are brought to his shop from the forest for daily sale. A *Vaid* told me that the

number of the important drugs, used in their system, is at least one thousand.

The old systems of medicine are being replaced by the new system, but a general reaction against the allopathic system has already set in and people are coming to think that indigenous systems of medicine are at times superior in their cures for organic and chronic diseases. The flourishing state of the *Kavirajas* in Bengal is an illustration of this reaction. There are many good points in the indigenous systems of the Hindi and Greek medicines that the modern science of medicine cannot afford to overlook, especially their peculiar suitability to the climate, constitution and circumstances of the Indian people. Besides, I venture to think that if some of these drugs are thoroughly investigated as to their chemical composition and physiological actions, they may well repay such study, and it would cause no surprise if at some future date they were to be recognised as good medicines by the modern physician as well. Whatever importance they may or may not have from a theoretical standpoint, it cannot be denied that a large mass of the people still depend on some of the most innocent and most powerful drugs, the use of which almost every Indian housewife knows.

The inland trade in these drugs is very large. By making local enquiries from some well-informed native druggists of Amritsar and Lahore, it has been roughly ascertained that there are possibilities of a trade of Rs. 50,00,000 in the Punjab only. The official figures of the import into Amritsar, the chief market for the Punjab, not being available as no separate record of each individual drug is kept by the Octroi Department, the results of the local enquiry have been taken as approximately correct for the purpose of this paper.

I may now proceed to deal with some of the most important drugs and forest products from the standpoint of the trade that is being carried on in them.

Kúth.

Kúth is the root of *Saussurea Lappa.* This plant occurs in Kashmir at a height of 10,000 to 13,000 feet. It is also found in the

north of the Chamba and Hazara districts of the Punjab. It is a very valuable raw material for producing a perfume which closely resembles in its odour the violet perfume, and is at present very highly priced. According to the commercial list of Messrs. Schimmel & Co., the oil is worth Rs. 150 per lb. According to Messrs. Gildmeister & Hoffman in their "Volatile Oils," p. 689, the roots yield 0·8—1 per cent. of volatile oil. According to my experiments, the fresh Kashmir roots gave 2 to 2·78 per cent. of oil on steam distillation. Taking the yield as 2 per cent, out of one maund of roots, we can get 1·6 lbs. of oil, which, at the rate quoted above, comes to be worth Rs. 240. The oil of this root is used as an adulterant of the violet perfume.

It is said that shawls perfumed by this root are not attacked by the insects.

Besides, the *Kúth* is greatly in demand in China for ritualistic purposes. It is burnt as an incense in temples of the Celestial Republic. Up to this time, it is collected only in Kashmir, where it grows in abundance. No attempt has been made to plant it in other places on any extensive scale.

Leaving for the present out of consideration, any demand that there may be in Europe for the oil distilled from this product, the local trade and Bombay exporters would take more than one thousand tons of it per year. Taking its price at Rs. 1,680 per ton, the total comes up to Rs. 16,80,000. There is every likelihood of its perfume becoming popular in India if for no other purpose than for perfuming the better class of woollen clothes, etc., and it will be safe to assert that there are good prospects before the *Kúth* cultivator in India.

Gul-i-banafsha.

Another product which is very commonly used all over the country is *Gul-i-banafsha*. The English name of this plant is wild violet or *Viola odorata*. These flowers contain an emetic active principle called *violin*, believed to resemble *emetine* in some of its characters; the flowers also contain in addition to traces of volatile oil, several peculiar colouring matters and *viola-quercitrin*, a yellow principle, and sugar. The flowers are used medicinally on

account of their demulcent, diuretic and mildly laxative properties. I found that 500 maunds of these flowers can be taken per year by the Amritsar market alone. Its price varies with the quality of the flowers. If the flowers are well dried in shade, retaining their original colour and are quite free from stalks and other impurities, the price varies from Rs. 60 per maund to Rs. 160 per maund. It seems to me quite feasible to have large plots of forest areas in the hills reserved for this plant and its cultivation could be carried out departmentally or otherwise. Taking the price of the first quality flowers at Rs. 160 per maund, the price of 500 maunds saleable at Amritsar alone comes to Rs. 90,000, and taking the minimum price it comes to Rs. 30,000. Looking to the large number of centres of sale in India, it would not be too much to say that a trade of a few lakhs already exists in the country, and this can be still further developed.

Ras or Rasaunt.

Rasaunt is another product that I wish to mention here. It is the aqueous extract of the roots of *Berberis aristata* and *B. Lycium*. At present this extract is very crudely made. I think consumers would be eager to take the extract if prepared by improved methods. Amritsar alone might purchase 1,000 maunds per year. It is used all over the country. The market rate of *Rasaunt* per maund is Rs. 16.

I would suggest that after careful determination of the total consumption for the whole of India, and if it is very large, the manufacture be started in a departmental factory as an experiment. The process of manufacture is quite simple and involves no great initial outlay of capital. After having shown the way, if it be considered inadvisable to maintain factories departmentally, they could be handed over to private enterprise.

Saffron or Kesar.

The stigmas of *Crocus sativus* or saffron are universally used in India. The price for the first quality is Rs. 3,200 per maund. On enquiry, it appears likely that the Amritsar market could take up 50 maunds per year, *i.e.*, Rs. 1,00,000 worth of saffron per year.

Up to this time, it is said to grow in one particular locality in Kashmir and a large quantity of inferior stuff is imported into India. Experimental cultivation at Quetta, as mentioned above, has been quite successful. An extended cultivation of this product is required to meet the demand of the country, which in all probability would run into lakhs of rupees.

I now take a few examples of the exotic plants that are in one form or the other being imported into this country.

Mulathi.

Mulathi is the root of *Glycyrrhiza glabra*, a perennial herb of South Europe, Asia Minor, Armenia, Siberia, Persia, Turkistan and Afghanistan. It is cultivated in Italy, France, Russia, Germany, Spain and China, and also to a small extent in England. It is not found either wild or cultivated in India. It is a daily necessary for every Pân-eater in India, and it is universally used medicinally in very large quantities all over the country. Its peculiar taste is due to the substance called *glycyrrhizin*, which is an amorphous yellow powder with a strong bitter-sweet taste and an acid reaction.

It sells at Rs. 12 per maund at Armitsar. Amritsar is stated to consume more than 1,000 maunds of this root per year.

Apparently there seems to be a very large trade in this product, and prospects of its cultivation in India seem to be full of promise.

Salab Misri or Salep.

Salab Misri, probably the root of *Orchis mascula*, is another very popular tonic known to Indian medicine. Mr. Hooper records an analysis of Salep obtained from the Lahore Bazar as follows :—

Moisture	9·65	per cent.
Albuminoids	8·62	„
Carbo-hydrates	77·73	„
Fibre	1·5	„
Ash	2·85	„
Phosphoric anhydride	9·55	„

This composition explains its popularity as a tonic with the Indian physicians. At present most of it is imported from Persia and Afghanistan. The exact botanical source of the true *Salab Misri* of the Indian Bazar is doubtfully known. It is believed to be obtained from *Orchis mascula* and other allied species. The tubers of *Eulophia campestris* found in Northern India are often sold as a substitute for the true Salep. The rates quoted at Amritsar for true Salep are from Rs. 135 to Rs. 320 per maund. It is believed that about 100 maunds of Salep could be disposed of annually at Amritsar. The cultivation of this product in our Indian forest seems to offer considerable promise.

Shir-khisht.

This is the vèrnacular name of manna derived from various species of trees in Persia and Arabia. It is supposed to be obtained from *Cotoneaster nummularia.* The whole of it is imported from the above-mentioned countries.

Quite recently it has been brought to my notice by the Superintendent of the Kotah Forests that the resin or manna exuded by a tree, he called 'Mokha,' of which he could not give me the exact botanical name, was collected by him and sent to Delhi and there fetched the same price as the imported stuff. Delhi is of course at present the centre of the Unani system of medicine. Some time ago, I received a sample of *Shir-khisht* from Rai Bahadur Pundit Keshavánand, retired E. D. C. of Forests, when he was in Kashmir, which was pronounced to be a good specimen of *Shir-khisht* by an Indian druggist, who came to see me. It was derived from *Olea cuspidata* (kau). Recently Mr. Hooper analysed a specimen of manna from *Gardenia turgida* (Roxb.).

I think with a little more attention bestowed on different kinds of manna found in India, it may be possible to meet the demand for *Shir-khisht,* especially by having the Indian manna medicinally tested by the Ayur Vedic and Unani physicians.

As regards the trade in this product, about 30 maunds of it could be sold in the Punjab markets. The price per maund ranges from Rs. 800 to Rs. 2,400. In the Punjab alone from Rs. 24,000

to Rs. 72,000 per year might be expected from the sale of this product.

Among other drugs, the following may be mentioned as being very popular and valuable products required for daily use in medicine :—

Músli-Sufed.

The roots of *Asparagus adscendens* (Roxb.) are called *Músli-Sufed.* This occurs wild in the forests of Rohilkhand and other parts of India. It is a very valuable tonic prized by all the followers of the native systems of medicine. It is used as a substitute for salep. Amritsar could perhaps take 50 maunds of this drug per year. The rate is Rs. 4 to Rs. 5 a seer.

Chaksu.

Chaksu is the vernacular name of the seeds of *Cassia Absus* (Linn.). It is an erect annual 1 to 2 feet high, growing at the foot of the Western Himalayas and thence ranging to Ceylon. It is valued at Rs. 28 to Rs. 50 per maund. About 400 maunds of this drug can be disposed of at Amritsar.

Filfil-dardz.

This is a very commonly used medicine. It is the fruit of *Piper longum* (Linn). It is said to be already cultivated in Bengal. A method of cultivation is given in the Dictionary of Economic Products (P. 805). Its price is Rs. 16 per maund, and apparently a very large quantity of this medicine is consumed in India every year.

Bal-chhar.

Bal-chhar is the root of *Nardostachys Jatamansi DC.*, a perennial herb of the Alpine Himalayas, which extends eastwards from Garhwal and ascends to 17,000 feet in Sikkim. It is much prized as a medicine and as a perfume, which, like *Kúth*, preserves woollen clothes from the attack of insects. As the trade stands at present, 400 maunds of this root could probably be sold at Amritsar at about Rs. 20 per maund. But I believe it can be still more extensively utilised as a source of perfume, its uses and market value in this connection, however, still remain to be ascertained.

Atis.

Atis, the root of *Aconitum heterophyllum*, is considered a very valuable tonic, and a large quantity of it is apparently consumed in every province. I am given to understand that the Punjab could take about 1,000 maunds. Its price is about Rs. 20 per maund.

I have above only cited a few examples out of hundreds of Indian drugs and given rough estimates of possible trade based on the opinions of experienced Indian *pansáries* or druggists of Amritsar and Lahore.

There are no official statistics available to assist me. What I have written, however, will show the great importance of an economic investigation into the chemistry and best methods of cultivation of these drugs and of collecting statistics of the inland trade in them. Almost every page of that monumental work of Sir George Watt, the "*Dictionary of Economic Products of India*," teems with reference to the uses of different barks, roots, flowers, leaves and woods for different medicinal purposes, to which he has added notes on the methods of cultivation of various drugs and the importance of the inland trade of some of them. Much botanical investigation into the scientific names of the various plants and drugs has already been accomplished, though more remains to be done in order to clear up many points as to the exact botanical sources of certain bazar drugs or new drugs that have escaped mention in the Dictionary. But the Dictionary and the Agricultural Ledger Files give more than sufficient data on which to prosecute further investigations.

What seems to be now required may be said to be as follows :—

(1) A complete survey of the extent of the inland trade in medicinal drugs mentioned in the Dictionary of Economic Products, and others found growing wild in the Indian forests, should be made in order to arrive at the figures of the annual consumption in the different provinces of India. Notes should also be made of the sources from which those

products are obtained at present, and also of the extent of the demand and possibility of expansion.

(2) After completion of this survey, it would perhaps be possible to make some organised attempt to preserve the forest areas where the more important of these drugs grow, to study the best methods of cultivation and, if need be, to extend this cultivation. Most of these drugs would naturally concern the Forest Department, but a few will, no doubt, be of greater interest to the Department of Agriculture.

I am afraid, at this stage, the already overworked Forest Department would hardly welcome suggestions for taking up investigations into additional minor products of the forest, though some of them, as I have shown above, are at least worth their weight in silver and gold, but it may not be out of place to suggest that such investigations may be found not unlikely to be remunerative and repay the additional labour involved by them. That this will be the case appears probable if the statistics of the Indian drug trade, which I have proposed in this paper should be collected, were to be published.

(3) The study of the chemistry of the more important of these drugs will not only be contributing new facts to the science of drug chemistry, but chemists in India by their joint study of these products may be expected to succeed in bringing some of them to the notice of the medical profession in whose hands they may well prove to be of great therapeutic value.

Investigations, carried out on these ines, would surely result in the opening up to chemical research of new and vast fields the economic and scientific importance of which it would be difficult to overrate.

The cultivation of indigenous drugs and generally of pharmacopœial drugs in India seems to open out new fields for the private capitalist, data being in the first instance available to

induce them to embark on such enterprises. It is to provide such data that I advocate the formation of a committee to thoroughly go into this question, and I submit the definite suggestion that (1) the British Pharmaceutical Conference should include India in their scheme for the cultivation of pharmacopœial drugs, plants and herbs likely to be of use in the manufacture of perfumes and essential oils, and (2) that the lines of work to be adopted for the cultivation of bazar drugs required by the Indian system should be discussed and laid down at any rate tentatively.

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BROADENING THE FOUNDATIONS.

1. There seems to be a general agreement on the part of those best qualified to judge, that the British Army has improved during the past few years in a remarkable manner. This is to be ascribed to two main causes. First, the adoption of the Divisional system which forms the skeleton on which to build up the flesh and blood of the Army. Secondly, the recognition of the necessity for clothing the dry bones of the skeleton with healthy flesh and blood built up and nourished by two great principles—

(*a*) that each rank has its own proper function,

(*b*) the encouragement of the initiative and individuality of every man. This recognition is emphasised by the dictum that the more each rank sticks to its own job, the more likely are the other ranks, and especially the subordinate ones, to carry out their own jobs successfully and intelligently. There is one reservation however. The whole fabric is based on the assumption that each man and each rank can be really relied on to do its best, provided proper scope is given to it. It must be added, too, that to this assumption is given great support by careful investigation before a Recruit is accepted.

Every man is led to believe and realise that though he is but a small part of the whole, the whole itself can only be efficient

though the small parts working whole-heartedly each in its own proper function. A new spirit has infused itself into the Army, and this spirit has already achieved a splendid result. There has been no magic in the process. It has been *solely due to* a wise and sound system of broadening the foundations of the Army by inculcating a real sense of responsibility in every individual man.

2. It cannot be unprofitable to raise the question whether in this respect all is well with our Department, and whether it is not possible for it to be built up on a surer foundation than it seems to rest upon now.

Taking the whole of India and speaking generally, are the services of the Range Establishments *being utilised to the best* advantage? Is there an effective chain of responsibility throughout all grades? Does every man really know what his sphere of work is? Does each man realise and act up to his knowledge that he is an indispensable and essential part of the whole?

If it is so, is it so in such a manner as to leave no doubt that a great and striking improvement is feasible?

If it is not, so would it not be possible—allowing for the difference in circumstances to apply to our Department the fundamental principles which have proved so signally successful in the case of the Army?

3. If the example of the Army can be soundly applied to a Civilian Department, then the two basic points we are concerned with are:—

(*a*) The development of the initiative and individuality of every single man.

(*b*) The determination of the functions of each grade of the Department with a view to the avoidance of overlapping and consequent loss of efficiency.

4. *In dealing with* a question, of such a wide and general nature, it is clear that an individual can only approach the subject in the light of his own experience, and it is clear, therefore, that this paper must be subject to that limitation.

5. With regard to the problem of the individual man, and so far at any rate as Madras is concerned, the present time seems to be an appropriate one for taking stock of the situation. For two innovations have recently been made which have radically altered the whole future outlook.

Until lately, the trained men in the Department were the Gazetted men and the Dehra Dun men. But Madras men could not attend the vernacular course at Dehra and the Dehra training was practically confined to the Provincial Service and men of the Ranger grade.

As time went on, it was found that the Dehra trained men were insufficient to leaven the lump. This is now to be remedied by the opening of the Training School at Coimbatore for Deputy Rangers and Foresters (? and untrained Rangers). Five or possibly ten years will be required before the result of this most important step can be appreciably felt. But the great step has been taken, and it is only a matter of a comparatively short time when it will be the exception rather than the rule, to find in the Department an untrained Deputy Ranger and much less an untrained Range Officer.

Nearly simultaneously, another great move forward has been made and schools for Guards have been opened. The benefit of these schools is felt immediately the Guards return to their work. Further, it can only be a matter of time, after all the Guards have been put through their course and even Refresher Courses, when the pick of the Watchers can be sent to the schools.

Here then are the beginnings of a great development. The means have been found whereby practically every literate man in the Department can be given a training. A chain of schools has been established wherein every Grade will be trained and whereby a man can work progressively and be trained progressively from one Grade to a higher Grade. Further, if the picked men of a lower Grade be regarded as a waiting list for promotions into vacancies as they occur in the higher Grade, we see a practical fulfilment of the theory that every man should carry his Baton in his knapsack. This is indeed "Broadening the Foundations" of the Department,

and on grounds far higher than their educational value, the establishment of these schools will have an influence which will be far reaching. For Napoleon's maxim as to "Morale" holds good with civilians equally as with soldiers.

There must be failures too. For, has not that rather overrated philosopher Aristotle told us in his Politics, "it may be that there are some persons whom it is impossible by any education to make into good men." At any rate, every man by working hard has now a chance which he never had before of improving himself and rising in the service. This must immensely increase the "morale" of the Department.

6. But all this—much as it is—only a means to an end. The attainment of the end lies for the most part in the hands of District Officers. The Department in Madras will in a few years be composed from top to bottom of trained men. Having arrived at this happy position, it will be essential to keep every man going forward. The Problem which remains to be solved is :—How is this to be done and done in such a way that the object desired will really be attained?

The first point to inculcate in a man is the fact that having been to school is merely the beginning and not the end of all things. This should be taught at the school itself.

The next step is to systematize the work of the Range. This can be done in two ways :—

(*a*) Work downward from the Ranger,

(*b*) Work upward from the Guard.

If we work downward from the Ranger, we run into the danger of establishing "a one-man show" or perhaps not even establishing that. If we work upward from the Guard, we broaden the foundations of our structure and any success met with will be an enduring and lasting success. If and when the Foresters and Guards feel that they occupy in their sphere as important and responsible positions as any one else in the Department, the routine work of a Range will go forward smoothly and automatically. The Ranger will then be free to utilise his higher training and his proper functions, and devote himself to the study and

development of his Range and the oversight and guidance of his Staff. Such results will not occur in a year or two. But seed sown now is sure to bear fruit hereafter. Such seed may not bear fruit an hundred fold, but it will yield a harvest which will be thankfully garnered by our successors.

7. There are many ways to Heaven, and the method advocated in this paper for systematizing the work of a Range by working upwards from the Guard and thereby placing the Range on a broad and secure foundation, is merely one of several possibilities. It is not a theoretical scheme, but one which is being used in actual practice, though, like all living schemes, it is a progressive scheme and makes no claim to finality or completeness.

The method suggested is a method which may be called the "Work Table" method. Although in its present application it is an innovation, there is nothing new in it. The idea dates back to B. C. 300, and probably a great deal earlier.

8. The preparation of a "Work Table" is simple enough on paper, but it requires a good deal of detailed care and probably more than one revision, to produce a useful result in practice.

All that has to be done is to take a Range Beat by Beat and write down what work is done or ought to be done in each Beat and the month during which such work can be most conveniently carried out. Every Guard will thus know what work he has to do in his Beat and the time of the year when it must be done.

Having completed the Beats, the next step is to decide how the Beats can be best grouped among the Deputy Rangers and Foresters available in each Range. Every Deputy Ranger or Forester will then know what work he has to do by studying the work which has to be done in each of the Beats allotted to him. There will probably, in addition, be certain works to be done in each section of a Range which are outside the scope of a Guard and which are peculiar to the functions of Deputy Ranger or Forester. If a list of such additional works is drawn up, this, together with the Beat works, will constitute the sum total of each Deputy Ranger's or Forester's Work Table.

The whole of these Work Tables are next bound up together and form the Range Work Table. The Ranger thus sees at a glance what establishment he has got, what work each man ought to be doing, and the time of year he ought to be engaged upon it.

If a man is trained, it is only a question of willingness on his part to carry out the works appointed for him. If a man is untrained, a Work Table seems an obvious way of helping him to learn what he has to do, provided he can read and write.

9. The subjoined extract from an actual Work Table is given as an illustration of the object aimed at. (*Vide* Appendix at the end of this paper.)

Most of the details enumerated in this appended illustrative extract are local matters. But a few words may be welcomed as to the Fire Scheme, as that is always a subject of general interest.

The Fire Protection of each Range is consolidated on to a special Fire Map for the Range. The Major Divisions, in charge of Deputy Rangers or Foresters, are indicated by coloured lines the Head-quarters by a filled-in green circle, each being serially lettered in green paint. The Minor Divisions are in charge of a Guard and the Head-quarters of each indicated by a filled-in yellow circle, and serially numbered in yellow paint. The stations of the Fire Patrols are marked by a red empty circle, one for each patrol in a station. Every Fire Line is numbered. Each map has two inset Tables. One Table contains a list of the Fire Lines, their names, serial numbers, and their length in miles and furlongs, together with the cost sanctioned for clearing and 1st and 2nd burning of the lines and the number and the pay of the Fire Patrols allotted for each line. The other inset Table contains the allotment of the Establishment by Major and Minor Divisions, the Patrol Stations, the Lines allotted to each Major and Minor Divisions and Patrols. The Map is therefore self-contained. Any Deputy Ranger or Forester (or Guard) can see at a glance what his work is, the money available for him to spend and the Establishment at his disposal for carrying out the works.

10. It must be understood that a "Work Table," in its forest application, refers only to annually recurring works and not to

Capital undertakings, such as the erection of buildings and bridges, road-making, etc. The execution or supervision on contract, of such Capital works as they are sanctioned, falls within the purview of the Deputy Ranger or Forester in whose section of the Range the work falls. They lie outside the Work Table and constitute extra work. They are not of such frequent occurrence, however, as to vitiate the routine of the Work Table. All possibility of misunderstanding with respect to these Capital works is obviated by a very simple expedient. When the estimate is framed, it is particularly stated who is to be in charge of the work, when it can most conveniently be commenced and the reasonable length of time which the work will occupy. As soon as the estimate is sanctioned, not only is the sanction intimated to the Ranger, but a copy of the estimate is sent to the Deputy Ranger or Forester concerned. In a backward District or in the case of an unusually big work, punctuality and smoothness can be still further secured by arranging for the collection of material in one season and the execution the following season.

By the adoption of this or some such method, a Deputy Ranger or Forester has ample time to realise what is to be done and when it is to be done and prepare his mind accordingly. If he does not know how it is to be done, he has time and opportunity before the work commences, to obtain advice and guidance.

11. If a Guard or Forester on appointment is turned loose into his charge without any particular specific instructions mapped out clearly for him, is it very surprising if that man makes no particular effort to attend to the details of his work, or if later on he fails to take an interest in doing what he finds by gradual experience he cannot very well avoid doing? Surely the first thing to attempt is to try and give a man an interest in his work: and how can this be done, except by first educating him and then giving him a specific outline of the work which he is expected to do in any given locality? In this way a man can be given a sense of responsibility from the outset. And a sense of responsibility is the prime sense it is desired to instil into every single man throughout the Department.

If, on the other hand, the majority of men of all grades are ready and willing to do work which they know how to do, not only is individual efficiency greatly increased, but it is possible to undertake work with success which otherwise one might not venture upon, on the ground that it would be premature to undertake it.

It may be argued that telling a man exactly what to do cramps his initiative, but a man must be set on the right lines, and he must have the principles on which he is to work put before him. There is ample scope for initiative in carrying out the details, *i.e.*, in applying the principles to suit the varying local circumstances in which each man may find himself.

12. There is another aspect of this question which deserves very serious consideration. It has a great moral effect on the population round a Forest, if they see that each man of the Forest Staff has a definite job to do. The people as a whole do not seriously complain of Reservation in itself. They complain—and complain quite rightly—that when Reservation has been completed, too often nothing is done by the Department to follow it up and effect something to show for it. This state of affairs is improving every year, and when the improvement embraces all Forest areas, a good deal of the ill-feeling towards the Department will disappear.

The ryot is by no means the ignorant fellow he is sometimes stated to be. He is quite capable of criticising what is being done in the neighbouring Reserve and is shrewd enough to discern whether the work is good or bad, or whether the Reserve is being put to a good use or not.

13. Although no one denies that the Department is still in the expansion stage, one of the chief difficulties in procuring the ever-recurring but requisite increases in establishment, appears to lie in the absence of a Standard whereby it may be judged whether such increase is necessary or not. Work Tables, if prepared with care, will probably supply this Standard. The one factor is the work to be done, the other factor is the establishment available to do it. If it is decided officially that the work proposed to be done is a necessary and useful work, the logic of the Work Table should be irresistible. Clearly, if these two

factors do not coincide and the establishment factor is the lesser of the two, the establishment must be increased to meet the admitted premiss that the work proposed is a necessary work.

14. The question of Continuity is one of the problems which the Department has got to solve if it is to make real and sound progress. In our present stage of evolution towards the Ideal, nothing can insure Continuity: or if there is something, is it not a pity that something has not been made more generally known?

The present average life of a generation in charge of a District or Range is probably about three to five years. Further, these generations overlap, so that the changes within a District are continuous and unceasing. Under such circumstances, a definite and tolerably accurate Work Table for every man in each Range must exert a tendency or "pull" towards Continuity, provided always that those who have charge of, or supervision over, a Range take a little interest in the Work Table and keep it corrected up to date. For several years to come Work Tables can have no finality. Within reasonable limits, the more men come and go, the sooner will the Work Tables become perfected according to the measure in which each man remedies his predecessor's omissions. Work Tables will in this manner not only make for Continuity but will act as a counterpoise to frequent transfers and will, for some years to come, actually divert into a benefit the unavoidable evil of changes of personnel.

15. The second central point for consideration is: What is each man's job?

It is assumed that the stage has now been reached wherein it is no longer a wise policy for any District or even a Range to be run as "a one-man show."

So far as a District Forest Officer is concerned, it is assumed that it is his duty to appreciate the situation for each Range, obtain sanction for carrying his appreciation and then see that its execution is effected on the right lines.

With regard to the Range Officer, it is assumed his duty lies in seeing that the work allotted to his Range is actually carried out punctually and in a workman-like manner.

Further, it is assumed that the unit for a District is the Range and the unit for a Range is the Beat.

If these assumptions are accepted as sound, it is clear that—speaking generally—a Range Officer cannot actually carry out the works of his Range himself, as he can only be in one place at a time. In short, it is the duty of the Range Officer to see that the execution is done, and it is the duty of the remainder of the Range Staff, *i.e.*, the Deputy Rangers, Foresters and Guards to actually do the works—receiving such guidance and help from the Range Officer as may be necessary. These assumptions and conclusions may not be accepted by the reader, but if they are, the reader must decide in his own mind how often or how seldom these assumptions and conclusions are adhered to in practice.

16. Supposing a Work Table to be in existence, a new District Forest Officer or Ranger can see at a glance the kind of Range that he is dealing with, and on what lines the Range can be developed. Inspection and Control are facilitated and thereby inquiries into, and plans for, further development of the Range may be narrowed into a concentrated focus from the outset. If such plans reach the stage of report and sanction, the Work Tables are amended accordingly, the existing staff know exactly what changes are to be made, and the future staff find a corrected and up-to-date set of Work Tables ready for them on which to repeat the process.

The preparation of the Annual Plan of Operations and the Budget is greatly facilitated by the Work Table. If there are no formal Working Plans in existence, the presence of an accurate and sound Work Table makes an excellent forerunner to a Working Plan. If there are Working Plans, the Work Table insures that the Plan is carried out.

Thus, as the structure increases, the foundations automatically and progressively broaden to carry the additional weight.

17. Lastly, the Recruiting question remains to be considered. The assurance of efficient men in the Permanent Staff is of the first importance. How often does it happen now that a man is

given an appointment and then turned loose into his Beat or Section of a Range? How many days a year does such a man spend in vaguely "inspecting the Forest"? Sooner or later a time comes when this man is given a specific work to do and then the collapse comes and the bubble is pricked. The bubble being, not the man's capacity but the want of system which placed the man in such a false situation.

With a Work Table ready to hand, a new man, whether trained or untrained, sees at a glance what his work is and when it has to be done. If he does not understand it, there is, or ought to be, the Ranger to help him and keep him in the right way. It can then soon be seen whether a new man is fitted or not for his work and is suited to a Forest life.

This information can be obtained during a man's Probationary Stage and the anomaly can be avoided of confirming men in their appointments and afterwards finding them to be wholly unsuitable for the work they have to carry out. For a willing man who is physically fit for his post, can and will pick up his work once he knows what to do.

No matter how perfect may be the system on which the Department is organised, and no matter how perfect may be the scheme of education, the foundations of the Department must consist in willing and suitable men.

18. To sum up, this paper has been written for the purpose of showing--

(*a*) that the foundations of the Department must be broadened,

(*b*) the lines on which it should be done.

(*c*) one particular method by which this object may be attained. It is a method which is suitable for untrained as well as for trained men.

19. In this matter we stand at the judgment seat of our successors. How are they to build, unless we see to it that the site is well and truly prepared?

F. FOULKES,
I. F. S.

BEGUR RANGE.

Section No. 1.

	Designation of the subordinate in charge.	Boundaries or limits of the section.	Beat Nos. of the Forest Guards in the section.	Name of the beat of the Guard.	Remarks.
Begur Range. Section No. 1. Name of section :— Tirunelli. Head-quarters :— (*a*) Tirunelli. (*b*) The Annual Timber Coupe.	1 Deputy Ranger.	1. While at Tirunelli. The whole of Tirunelli, Hilldale, Huntley, Trichileri A & B, Harihara shola and Kambaumalai (comprising the whole of Major Division E as per Fire Scheme Map, *vide* appendix to the Begur Range Manual).	7 8 9	North Tirunelli Central do. South do.	One Forester (who will be stationed at Tirunelli throughout the year) to assist the Deputy Ranger. The Forester will be in charge of Tirunelli while the Deputy Ranger is about at the Annual Timber Coupe.
		2. While at the Annual Timber Coupe.	3 5	South Begur Tholpatty	

BEGUR RANGE.

SECTION I.

Work Table.

JANUARY.	FEBRUARY.	MARCH.
Head-quarters:—Tirunelli.	Head-quarters:—Tirunelli.	Head-quarters:—Tirunelli.
(1) Fire-protection. *Vide* Range Fire Scheme, E Major, 6, 7, 8, 9 and 10 Minor Divisions. Start first burning of line Nos. 14, 16 and 17, length 10 miles 6 furlongs to a width of 140 feet for line No. 14 and 40 feet for line Nos. 16 and 17, with 20 coolies. Line No. 19, length 11 miles, to a width of 140 feet, with 20 coolies. Line Nos. 20, 21 and 23, length 9 miles to a width of 60 feet, and line No. 22 to a width of 80 feet, with 20 coolies. Line No. 15, length 10 miles to a width of 60 feet, and line No. 18, length 6 furlongs, to a width of 40 feet, with 20 coolies. (2) General repairs to buildings:— (*a*) Deputy Ranger's quarters at Tirunelli. (*b*) Forest Guard's Station at Tirunelli. (*c*) Rest House at Brahmagiri. (*d*) Servants' quarters and kitchen attached to Brahmagiri Rest House. (3) Map rosewood regeneration in the grass area of Tirunelli and Hilldale blocks. Record the height measurements of this regeneration.	(1) Fire-protection. *Vide* Range Fire Scheme, E Major, 6, 7, 8, 9 and 10 Minor Divisions. Start and complete second burning of line Nos. 14, 16 and 17, length 10 miles 6 furlongs to a width of 140 feet, for line No. 14 and 40 feet for line Nos. 16 and 17, with 20 coolies. Line No. 19, length 11 miles to a width of 140 feet, with 20 coolies. Line Nos. 20, 21 and 23, length 9 miles to a width of 60 feet, and line No. 22 to a width of 80 feet, with 20 coolies. Line No. 15, length 10 miles to a width of 60 feet; line No. 18, length 6 furlongs to a width of 40 feet, with 20 coolies. (2) Completion of repairs to the following buildings:— (*a*) Deputy Ranger's quarters at Tirunelli. (*b*) Forest Guard's Station at Tirunelli. (*c*) Rest House at Brahmagiri. (*d*) Servants' quarters and kitchen attached to Brahmagiri Rest House.	(1) Fire-protection. *Vide* Range Fire Scheme, E Major, 6, 7, 8, 9 and 10 Minor Divisions; arrange for the proper patrolling of Fire line Nos. 14, 15, 16, 17, 18, 19, 20, 21, 22 and 23, and check the lines to see if they are free from combustible matter. Make sure that the Guards and Patrols are living on the lines. (2) Check and endorse permits for removal of Forest produce. (3) Submission of weekly acreage statement. (4) Submission of weekly skirmishing statement. *Forester.* (1) Assist Deputy Ranger. (2) Submission of weekly acreage statement. (3) Submission of weekly skirmishing statement.

BEGUR RANGE.—*concld.*

JANUARY.	FEBRUARY.	MARCH.
(4) Locate and prepare sketch showing the Sholas.	(3) The posts planted round the Shola, for lead measuring its increase, near the Brahmagiri Bungalow should be replaced if any posts are fallen or missing. Fresh posts to be planted on the edge of the current year's increased extension of the Shola limits over the previous year.	
(5) Prepare and submit estimates for clearing and burning fire lines so as to divide the areas between the Sholas into convenient blocks.		
(6) Submission of weekly acreage statement.	(4) Submission of weekly acreage statement.	
(7) Submission of weekly skirmishing statement.	(5) Submission of weekly skirmishing statement.	
Forester.	*Forester.*	
(1) Assist Deputy Ranger.	(1) Assist Deputy Ranger.	
(2) Submission of weekly acreage statement.	(2) Submission of weekly acreage statement.	
(3) Submission of weekly skirmishing statement.	(3) Submission of weekly skirmishing statement.	

A DESCRIPTION WITH NOTES ON THE WORKING OF THE *CASUARINA* PLANTATIONS OF THE NORTH KANARA COAST.

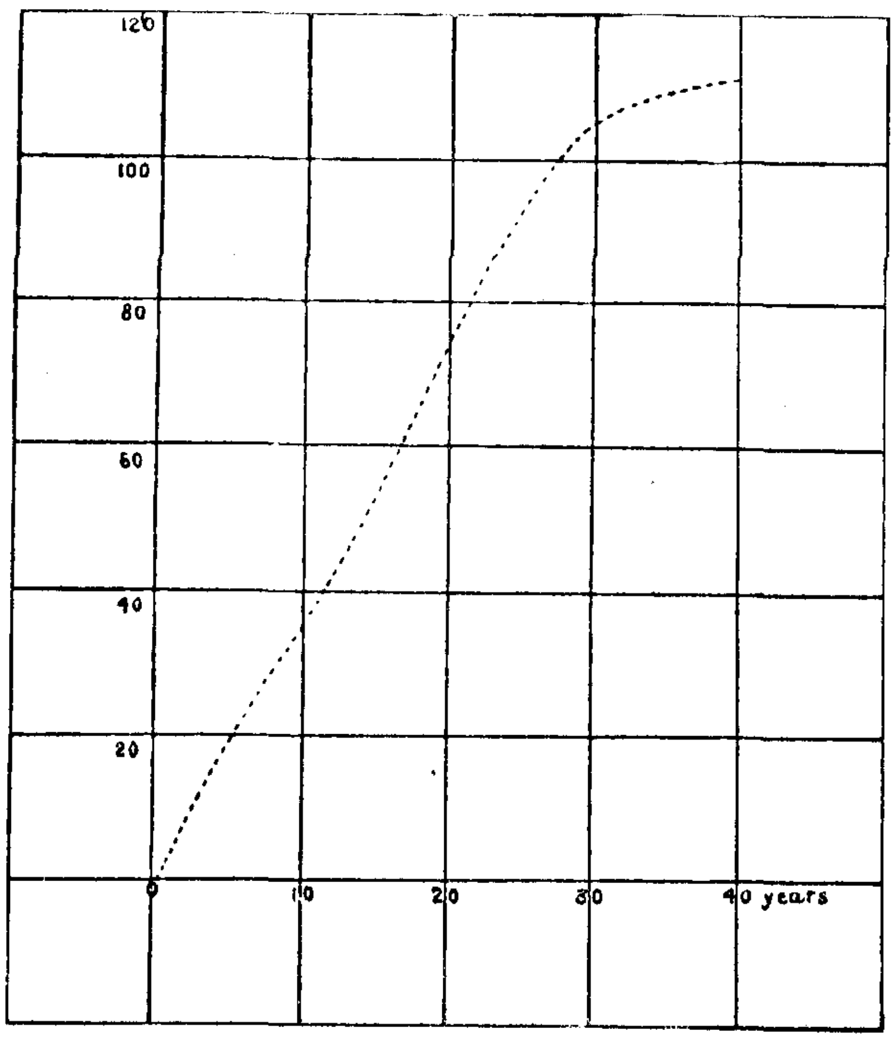
It has been suggested to me that some description of the Casuarina Plantations of the West Coast would be of interest to readers of the *Indian Forester.* I was fortunate in assisting Mr. Pearson (now Forest Economist) to prepare the Working Plan for these plantations, the first Plan, I believe, prepared in India in which the rotation was fixed on purely financial considerations, checked by the rotation of greatest volume in accordance with the methods taught us by Sir William Schlich.

Since the Plan was sanctioned I have been again fortunate in holding for three years the Division in which the greater portion of these plantations are situated.

The Casuarina (*Casuarina equisetifolia*) is an exotic in India. It is, I believe, indigenous in Persia and from there was taken to Australia, whence it was introduced into this country. In habit the tree bears great resemblance to the conifers, and the resemblance is further borne out by the fruits. These are small cones formed of the hardened bracts and bracteoles of the female flower enclosing the winged achenes. The needles fall throughout the year and if left alone form a thick layer of humus. In the plantations near Karwar the fallen needles are regularly swept up by poor people and used for fuel. This practice, though it will probably appear to most readers as a scandalous defection from all the canons of scientific forestry, has to be allowed. It does not seem to have any bad effects, but, on the contrary, appears to be beneficial, as in the other plantations where humus is not removed it becomes acid and the trees do not appear to thrive so well. This is probably due to the heavy rainfall during the monsoon saturating the humus and inducing the growth of the fungi. An additional reason for allowing this removal of humus is that it obviates danger from fire. The tree is particularly susceptible to damage from fire. In the plantations where the people do not remove the humus small fires are frequent, and are very difficult to prevent. Many trees have died in this plantation entirely, I believe, owing to their being killed by these fires.

According to Talbot's "Forest Flora of the Bombay Presidency," the trees flower in September-October and the fruit is ripe in June. Here the trees certainly flower twice in the year, in March-April and September-October. From my observations it seems that the fruit from the first flowering which is not so prolific as the second ripens in June and from the second about December.

CURVE OF HEIGHT GROWTH OF THE 15 OLDEST SAMPLE TREES.



The height and diameter growth can be best judged from the accompanying curves taken from the Working-Plan. It should, however, be remembered that diameter growth was taken from test trees from the plantations which had not been properly thinned. When proper thinnings are carried out, as is laid down in the Plan, the rate of growth will probably improve. The average girth at breast height of 12 dominant trees selected at random in the small portion of the oldest plantation remaining unfelled is :—

1 ...	5′ 8″	7 ...	6′ 10″	Their total height is about 140 feet and the bole is clear for about 80 feet.
2 ...	5′ 10″	8 ...	5′ 2″	
3 ...	5′ 10″	9 ...	5′ 5″	
4 ...	6′ 9″	10 ...	5′ 0″	
5 ...	6′ 2″	11 ...	5′ 7″	
6 ...	5′ 8″	12 ...	7′ 0″	

The wood is hard but brittle. The tree is grown entirely for the fuel it yields which is excellent. The wood will burn well even when green.

The species was first introduced into Kanara in 1868-69 when, by the orders of the Collector ; 10 acres of land on the seashore at Karwar were planted as well as avenue trees along the main roads. The plantation was further extended in the year 1874-76, at the end of which year its area was 45 acres. From this time up to 1878 the plantations were continued amounting in all at that date to about 80 acres. Between 1880 and 1889 plantations were started at other places further down the coast at Binge, Arge and Harvada. In 1903-04 another plantation was started at Gangawali, and in 1908-09 a new accretion, formed on the opposite side of the river to the first plantation, was handed over by the Customs to the Forest Department for planting. The area brought under the Working-Plan was 560 acres of which approximately 260 were stocked and 300 blank ; since that time over 100 acres of the blank area has been stocked.

The plantations as has been said are on the seacoast and are with one exception actually on the shore extending inland for one or two furlongs from the beach. In the Kodibag, Chittakule and Gangawali plantations the soil consists of pure sand with the

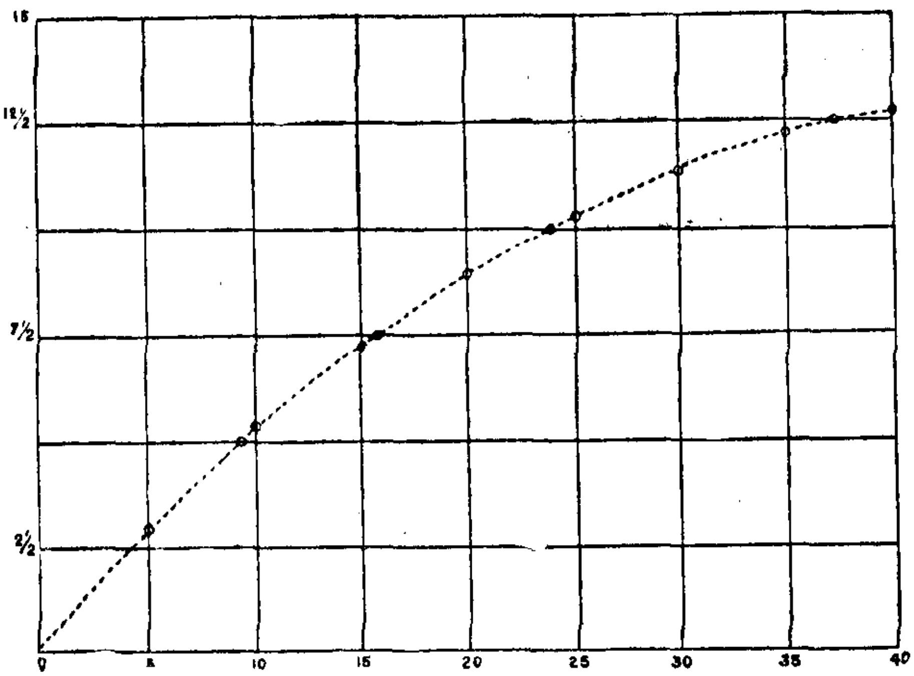
subsoil water at a depth of 8 to 12 feet. In Arge and Harvada there is a large admixture of shell with the sand and the subsoil water is at a greater depth, being 20 to 25 feet below the surface. In these plantations, too, the sand cakes, forming hard layers at various depths which make it more difficult to establish the crop.

The rainfall averages about 120 inches during the monsoon. From November to the beginning of June there is no rainfall, except an occasional shower.

The plants for the nursery are to a large extent collected from natural seedlings which spring up in large quantities in open spaces on the edge of the old plantation towards the end of the monsoon. They are now also raised from seed in seed-beds, but the method mentioned was the only one formerly used and the Indian is conservative. The seedlings are pricked out in the nursery beds at least 6 inches apart. The greatest difficulty, in fact the only difficulty, experienced in raising the plants in the nursery is from the attacks of *Brachytrupes achœtinus*.

This pest described in the recent Forest Bulletin No. 11 will devastate whole nursery beds in a single night. We take the following precautions :—The nurseries are fenced round with a thick close fence 3 to 4 feet high. Outside the fence a strip about 20 yards broad must be cleared of all vegetation. The insects do not fly but only hop, and by this means the majority of them are kept out of the nursery. Any that do obtain admittance must be immediately dug out of their burrows and killed. A dressing of wood ashes does not appear to be congenial to the insects and probably soot would be an efficient preventative, but it is unobtainable here. This year the insects appeared earlier than usual and attacked the plants planted out in the plantation biting through the leading shoot and branches over $\frac{1}{10}$ of an inch in diameter, the whole plants being cleared. I have never before observed them attacking such large plants and up till now considered that when the stem and branches had become woody the plants were immune to their attacks. The seedlings grow rapidly and by the beginning of the next monsoon are 18 inches to 2 feet high.

MEAN BASAL DIAMETER CURVE.



If the plants were manured much faster growth than this could easily be attained. I had one nursery bed in a place where the *mali* had been accustomed to throw his household refuse. In this bed the plants grew 6 to 8 feet high in eight months. Such plants are too unwieldy for easy transplanting, and they do not maintain this forced growth when planted out, and at the end of a year in the plantation are no better than others which have not been forced in the nursery beds. Owing to these considerations manuring seems to be quite unnecessary. As soon as the rains set in, plants are transferred to the plantation. They are planted out 10′ × 10′. The plants thrive much better if care is taken in lifting them from the nursery bed, not to break the taproot, and it is also essential that the planting hole is sufficiently deep for the taproot to be placed in a natural position. The plants put out in June grow another foot to 18 inches during the rains.

During their first dry season the plants have to be watered daily. They are then quite established in the plantation where the subsoil water is not deeper than 12 feet. Other plantations, or at any rate portions of them, require to be watered a second year, particularly in the hot weather if the plants are observed to be failing.

The experiment was made last year of putting a tube of bamboo about a foot long in the sand near the plants and sloping down towards them. These plants were watered only every other day and later on every three days and were found to thrive equally well with the others. This year this method is being extended to all the plantations. The rate of growth, once the plants are established, is marvellous. In the third monsoon it is difficult to push through the plantation, about the fifth the lower branches have practically all died off and in the sixth to seventh year the boles are quite clear to a height of 8 or 10 feet. The rate of growth at this stage can be judged from the following figures, the plants having been eight months in the nursery before being planted out :—

	Average height.	Girth at base.
Planted in the year 1911—		
1 year 6 months in plantation ...	17′	8″
Planted in the year 1910—		
2 years 6 months in plantation ...	30′	1′
Planted in the year 1908 —		Girth at breast height.
4 years 6 months in plantation ...	40′—45′	1′-5½″

According to the provisions of the Working—Plan, thinnings should be made when the plantations attain the age of 10 and 20 years. This will in practice have to be modified, and probably three thinnings will be necessary at the age of 8, 16 and 24 years in the best areas. In the 8-year old plantations thinnings were this year absolutely necessary and about fifty trees per acre of dominated trees were removed.

In order to get a definite idea as to the ages at which thinnings are necessary, one area of 11 acres has been divided into five experimental plots. These are to be thinned according to the

following provisions. All are planted 10′ × 10′ giving 430 trees per acre :—

Plot No. 1 ...1/2 removed when 6 years old, leaves 200 per acre.
1/2 the remaining crop removed, 12 years old, leaves 110 per acre.
1/3 „ „ 18 „ „ 75 „
1/3 „ „ 24 „ „ 50 „

Plot No. 2... 1/3 removed when 6 years old, leaves 300 per acre.
1/3 the remaining crop removed, 12 years old, leaves 200 per acre.
1/2 „ „ 18 „ „ 100 „
1/2 „ „ 24 „ „ 50 „

Plot No. 3... 1/5 removed when 6 years old, leaves 340 per acre.
1/5 the remaining crop removed, 11 years old, leaves 270 per acre.
1/3 „ „ 16 „ „ 180 „
1/2 „ „ 21 „ „ 90 „
1/2 „ „ 26 „ „ 45 „

Plot No. 4... 1/2 removed when 6 years old, leaves 220 per acre.
1/2 „ 14 „ „ 100 „
1/2 „ 22 „ „ 55 „

Plot No. 5... 1/3 removed at 5 years old, leaves 300 per acre.
2/3 „ 14 „ „ 100 „
1/2 „ 23 „ „ 50 „

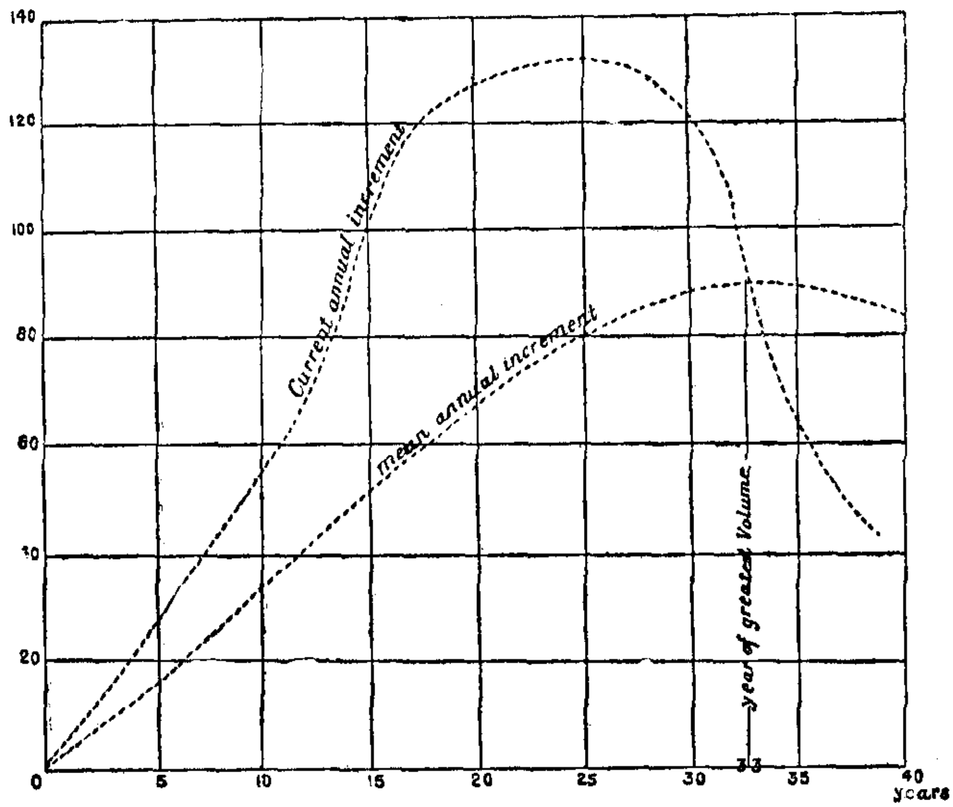
The rotation for these plantations has been fixed from considerations of the financial rotation and rotation of greatest volume at 30 years.

Financial yield table for one acre of Casuarinas.

a	b	c	d	e	f
Length of rotation in years.	Gross value of yield in rupees per acre.	Cost of formation at Rs. 25 per acre with compound interest at 4 per cent. up to date in rupees.	Net value of yield less cost of formation b—c.	Capitalization factor value of $\frac{1 \cdot 04^r - 1}{.04}$	Soil net rental. $\frac{D}{e}$
	Rs.	Rs.	Rs.		
15 ...	90	45	45	20·024	2·24
20 ...	156	55	101	29·837	3·35
25 ...	246	66	180	41·646	4·33
30 ...	324	81	243	57·726	4·21
35 ...	372	99	273	73·659	3·70
40 ...	400	120	280	95·021	2·94

From the financial yield table taken from the Working-Plan, it is seen that the soil net rental reaches a maximum at about 27 years, whilst from the curves of current and mean annual increment

CURVES OF CURRENT AND MEAN ANNUAL INCREMENT GIVING ROTATION OF GREATEST VOLUME.



the rotation of greatest volume is 33 years. From these considerations the rotation was fixed at 30 years. The returns from thinnings were not included in the financial yield table, as up to the time that the Working-Plan was made no regular thinnings had been attempted so that no idea of their value could be estimated.

The plantations are particularly adapted for management under a financial rotation. The wood is all exported to Bombay, where it fetches a good price. Local demands are adequately met

from other sources. The plantations are also not handicapped from the financial point of view by the exercise of any privileges.

Last year the average price per acre for a coupe, 43 years old was Rs. 416 per acre. This year the coupe fetched Rs. 595 per acre. According to the table given above the price per acre expected to be realised is given as Rs. 324 at 30 years. However, with proper thinnings I think it is most probable that a well-grown 30-year old coupe will fetch Rs. 400 per acre. When the whole area is planted, and is working under the rotation of 30 years the average area to be felled yearly will be about 18 acres. There are no data from which the probable returns from thinnings can be calculated, but I think it may be safely assumed that they will easily cover the cost of re-planting the felled area and maintenance of the plantations. If this is correct the proceeds of the sale of the year's coupe can be taken as the annual net revenue. This would be Rs. 7,200 or an average rate of nearly Rs. 13 per acre per annum. During the present rotation during which over half the area has to be stocked the plantations are expected to yield about Rs. 4-4-0 per acre per annum during the first half of the period rising to Rs. 6-8-0 during the latter half.

W. A. MILLER,
I. F. S.

BAMBOOS AND THE DIFFERENT METHODS OF CUTTING THEM.

As I believe that opinions differ considerably as to the correct method of felling bamboos, I am sending up this note, not with a view to advocating any particular method, but simply as a statement of facts noticed recently in the South Malabar Division of the Madras Presidency, in the hope that it may be of interest to some officers who have to deal largely with bamboos.

Throughout this district bamboos are used very largely for floating timber and some 50,000 are required annually for the use of the Forest Department alone.

The method of cutting the bamboos, which appears to have been in practice in the District ever since bamboos were first used for timber floating, is for coolies to climb up into the clump with the help of single bamboo laid against the clump and then to cut off simply the top half of such bamboos as are required, about 20 feet from the ground.

On first coming to the district this method appeared to me extremely wasteful and in fact undesirable from every point of view, more especially as I had just left a district where the sale of bamboos formed one of the chief items of revenue and where one of the main points, which the contractors who bought the bamboo coupes were supposed to observe, was that no bamboo was to be cut more than, I think, a foot or 2 feet above the ground.

Incidentally, this was also one of the chief points over which the contractors laid themselves open to trouble, by breaking the rule, and so the effect on the clumps of what, in that division, was supposed to be the only correct way of cutting the bamboos was seldom brought prominently to notice.

On making enquiries here with a view to utilizing a greater length of the bamboos than was being done both with the object of economy and in order to make the clumps look rather less pitiful objects after the cutting was over, it was pointed out to me that, firstly, the rate for cutting, which is Rs. 2 per 100, would be approximately doubled if the bamboos were cut at the bottom, owing to the dense thorns; and secondly, that the heavy butt ends would be no use for floating.

I reluctantly decided, therefore, that it was no use trying to alter the system.

However, when the vernacular training school for Forest Guards was stationed in this division at the beginning of the year, one of the things taught them by the Instructor, a ranger who had himself served, not here on the West Coast, but in districts such as the one I have mentioned, where bamboo coupes were sold no doubt to contractors as a rule, was the method of felling bamboos.

He dealt with four clumps and took out in all 99 green bamboos and 109 dead lengths which were left from the cuttings of previous years. He left 35 sound bamboos standing, about 9 in each clump, evenly scattered throughout the clump. All the thorns had necessarily to be removed in order to get out the bamboos, which were cut about 1½ feet above the ground.

I saw the clumps just after the work was finished, about April last. I was very sceptical as to what the effect would be on the root system, as also as to the possibility of the remaining bamboos standing upright through the monsoon, although they were sheltered by being in the middle of a dense bamboo forest.

To-day, on visiting the place and inspecting three of the clumps carefully, I found every bamboo blown over and either broken or leaning up against the adjoining clumps, and in two of

the clumps, not a single new bamboo had sprouted up, though in almost all the neighbouring clumps new bamboos had grown up during the monsoon. In the third clump two miserably thin bamboos had sprouted up. One had lost its leader after growing about 3 feet, and the other had been blown over and was broken as it was not able to sustain its own weight.

Whether the clumps will ever recover I am unable to say. The root system did not appear to be by any means dead and there had been some effort at sending up some sort of coppice shoots which might in time reform the thorny thicket through which big shoots might be thrust up.

NILAMBUR : A. WIMBUSH,
22nd November 1912. I.F.S.

NOTE ON THE BREEDING OF ELEPHANTS IN CAPTIVITY.

Details on this subject are not frequently reported, and it may be of interest if a few notes on a recent birth to one of the working elephants in this district are recorded.

Farah, the elephant in question, is an excellent cow in every way, measuring 7′ 4½″ at the shoulder.

She was known to have been repeatedly served by a very fine captive tusker (8′ 6½″) and the following occasions are on record :— July 1909, end of October of the same year, 16th January 1911 and 29th July 1911. The tusker showed no signs of "musth" on the first and last occasions, but did on the two intermediate ones and became very troublesome. He was again "musth" in December 1911 and January 1912. Normally he is a very placid and somewhat lazy animal.

Conception followed on the last-mentioned occasion and signs of pregnancy were first observed in September 1911. *Farah* was delivered of a male calf on the 21st November 1912. The period of gestation was, therefore, a few days short of 17 months, a term which agrees closely, if I remember correctly, with that placed on record in the pages of the *Indian Forester* a few years ago by Mr. C. B. Smales.

The calf was measured as carefully as possible by Ranger Mr. P. Venkatramanan on the 24th November, *i.e.*, when 3 days old, as follows: Length from tip of trunk to tip of tail 6′ 6″; length of trunk 14″; height at shoulder 3′ 1″. Owing to the restless activity of the calf the measurements are not absolutely accurate, but very nearly so. The mother would not brook anything like coercion in keeping her offspring still.

In connection with this birth a rather amusing circumstance may be related. When the elephant camp was moved at the beginning of the last monsoon, this elephant and another cow *Garudachi* were left behind because of their condition, the second having been in poor health and very thin ever since her capture in the previous September. At the end of June a report reached me that *Farah* had been delivered of a still-born calf. This was most regrettable news, as a fine calf had been expected from the union of such fine parents. I presumed that the birth was premature. It was not till the end of August, when these two cows had rejoined the other elephants, that the first suspicion arose that *Farah* was still carrying her calf and that it was *Garudachi* that had produced the still-born one. This was hesitatingly advanced by the Forester in charge of the elephants. An inspection of *Farah* left no doubt and on the mahouts being closely examined, it transpired that when the unformed calf was found in the morning *Garudachi* was near it and *Farah* some distance off, but as there had never been any suspicion that the former was pregnant the birth was very naturally attributed to the latter.

While on the subject of elephants I may mention that in August last year it was found necessary to saw off three inches of the tips of both tusks of a young bull as they had grown inwards to such an extent that he could not pass his trunk up between them and this interfered with his feeding in the forest. In exactly one year the tusks had grown in again and it became necessary to repeat the operation; this time a piece, 8 inches in length, was removed from each tusk.

COIMBATORE:
8th December 1912.

C. E. C. FISCHER,
Deputy Conservator, Forests.

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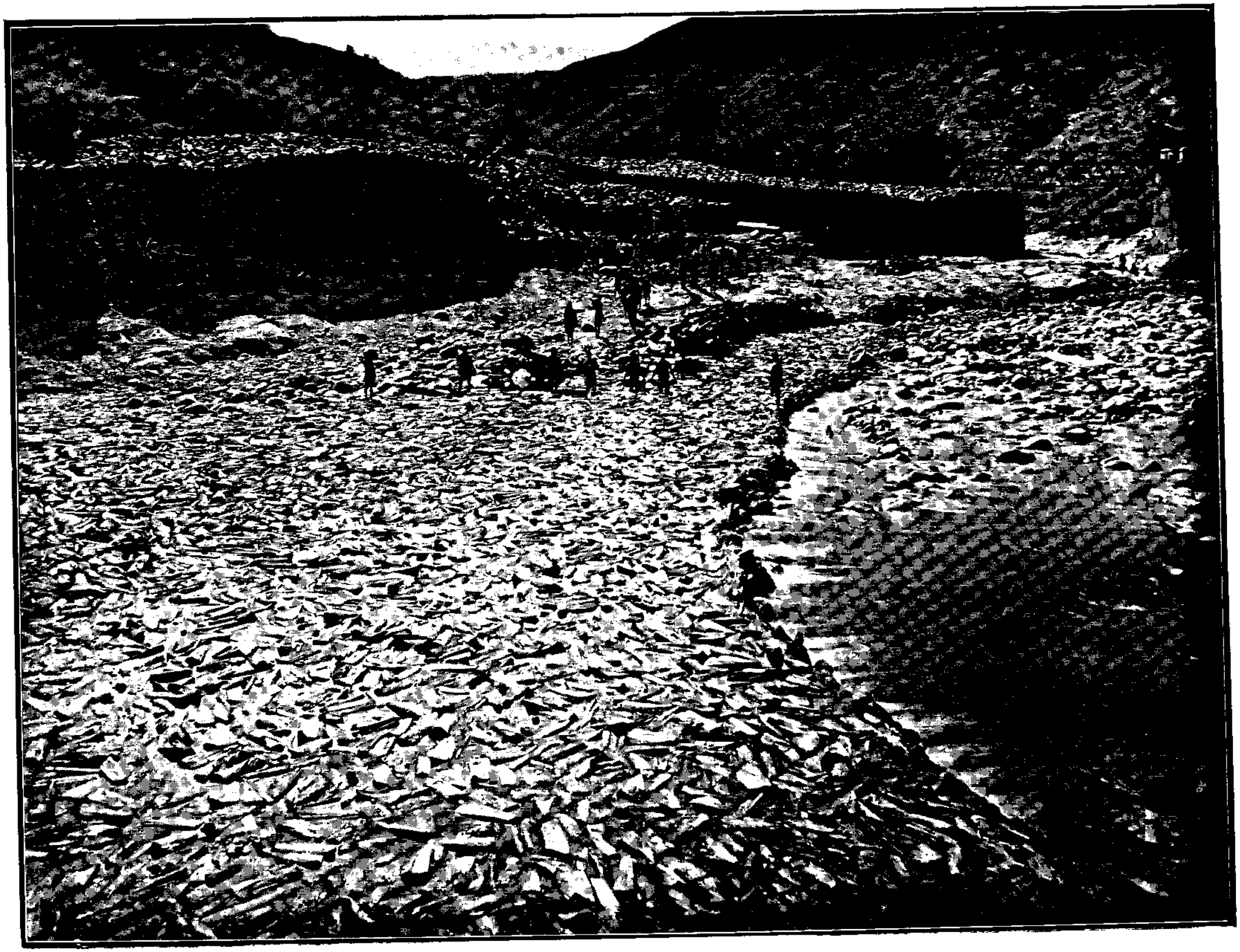
THE SUPPLY OF RAILWAY SLEEPERS IN INDIA.

It has been asked and not without justice why the forests of India which cover between 24 per cent to 25 per cent of the country cannot fully meet the demand made by the Railway Companies for suitable sleepers? The answer is largely dependent on the question of price and outturn. For instance, the best sleeper wood in India and Burma is Teak, which many years ago was used for sleepers, but which is now only employed for that purpose in special cases, such as on bridges, at points, in stations, etc. The reason why Teak is not used to-day for railway ties is that it is used for other purposes for which a very much higher price can be paid. Teak, of which no less than 220,000 tons are annually extracted from Burma alone, may therefore be said to be ruled out of court as far as sleepers are concerned, except possibly in Kanara where M. G. Teak sleepers are prepared from butts and top ends.

Sál stands on a different footing; as compared with other sleeper-woods, the price has risen hardly 10 per cent in the last 20 years, while that of Deodar has doubled during that period. Some



may doubt this statement but it is nevertheless correct. The outturn of Sál sleepers from Government and private forests is on the average for 5 years, just over 1,100,000 sleepers annually; the number of sleepers extracted annually has if anything decreased, due to overcutting in some of the Feudatory States, in the past, which has restricted the supply of Sál sleepers from them for the time being or possibly for all time, unless measures are taken for the strict conservancy of their forests.

The only indigenous conifer sleeper used is Deodar, the outturn of which is restricted to N.-W. India, the majority of sleepers being used by the North-Western and Oudh & Rohilkhand Railways. The price of this timber has risen enormously during the last 20 years, at one time B. G. sleepers could be purchased for Rs. 2-8-0 and Rs. 2-12-0--now the price varies between Rs. 3-14-0 and Rs. 4-2-0 or even higher. It is thought that for some years to come the annual output will not materially increase.

The fourth most important species of sleeper, and for that matter the most important one in Burma, is Pyinkado. The Burma Railways are said to have difficulty in obtaining all the Pyinkado sleepers they require, the reason for this is, anyhow in the writer's opinion, not because there is an insufficient quantity of the timber available, but because the price offered allows a minimum amount of profit to the contractor supplying the sleepers.

Several other species of timber are used locally, the most important of which is Nahor (*Mesua ferrea*) used by the Assam-Bengal Railway, *Terminalia tomentosa*, *Bischofia javanica*, etc.

There is not the least doubt that the available number of Sál, Deodar, Pyinkado and other sleepers mentioned above is quite insufficient to meet the present demand, while with the ever-increasing mileage of railways in India, the supply will fall even further short of the requirements. It is with this state of affairs that the Railway Engineers are now confronted, and have been for some years. It is interesting to review how they have tried to solve the problem. Iron sleepers have been tried, with the result that some railways in India have at present long lengths of line laid in this way, however most of them have returned to the

wooden tie, and for various reasons, amongst which may be mentioned the high cost of iron sleepers, their tendency to crack, and the stiffness of the line laid with such sleeper. In England iron ties were given an extensive trial but have been practically rejected in favour of Creosoted wooden sleepers. The other way out of the difficulty was to import wooden sleepers; creo-pine sleepers were introduced from Europe and in some cases answered very fairly well. However, by far the most important step was taken by introducing large quantities of Australian hardwoods such as Jarrah, Blue-Gum, White Mahogany, White Stringybark, Grey-Box, Grey-Gum, Tallow-wood, Iron-bark, Turpentine, Blackbutt, etc. This might have finally settled the question were it not for the fact that the timbers are not entirely satisfactory and in some cases have failed completely. Their price is high, varying between Rs. 4-14-0 and Rs. 5-3-0 for B. G. sleepers which is about the price of the best hill-grown Sál. The writer has asked many Engineers in various parts of India to express an opinion on these Australian timbers, and in the case of Jarrah, for instance, the answer has been that they are not altogether satisfactory as sleepers, and being asked why they use them, the answer is invariably because "we can get nothing else." While recently inspecting some Powellized sleepers laid in the line on the Oudh and Rohilkhand Railway, with the District Executive Engineer, the writer had occasion to inspect 5 or 6 lots of experimental Australian sleepers laid down some 7 years ago, the Grey-Gum had withstood the wear and tear fairly well and was not much split, the other sleepers were failing in most instances. On discussing the subject of sleepers and their supply in India, the Executive Engineer gave it as his opinion that the time would come when they would be forced to revert to iron sleepers for want of sound wooden ties.

It is understood that one of the Indian railways has recently purchased 80,000 Creosoted Oregon pine sleepers; the timber is fair to good for sleepers as far as conifer woods go; we all know the Douglas, whether of Oregon or Vancouver varieties. It is certainly inferior to "Kail" (*Pinus excelsa*) though possibly a shade better than "Chir" (***Pinus longifolia***), however there is little

to choose between them. It is quite possible the Oregon pine, well Creosoted, will answer the purpose quite well, though it can hardly be expected to come up to untreated Sál or Pyinkado.

The position of the sleeper wood supply has been briefly reviewed above, it is quite certain that the supply is short, it is equally certain that the Railway Engineer is on the look out for a substitute or more correctly for a sleeper which will make up the balance he requires. If he is willing to give Creosoted Oregon pine wood of which he has little experience, and also Australian timbers, a fair trial, it is quite probable that he would give Indian treated timbers a trial also, provided the price were not excessive and the supply fairly large and regular. As an instance of the direction in which matters are moving it is of interest to note that a large Calcutta firm has recently made enquiries for *Dipterocarp* sleepers, which they proposed to treat and sell to a Railway Company and that another firm is considering the possibility of following their lead.

It would be wrong to allow such an opportunity to pass without seriously attempting to capture a portion of the sleeper wood market by putting some of our Indian timbers forward, which we know to be mechanically strong enough for the purpose, but which require treatment to make them more durable. A large commercial firm with the same opportunities would certainly endeavour to do so.

The question is what steps should be taken to carry out such an enterprise. The subject will have to be treated from a broad standpoint, immediate high returns cannot be expected. When forests are newly opened up it is not unusual to carry out work departmentally for a few years, and as the place becomes known and contractors appear on the scenes the departmental work is dropped and contracts are given. It is thought that the same principles should be followed in this case. A Conservator might prepare 20,000 sleepers and sell them to a firm who deal in this commodity, who would treat and sell them on to the railways. Possibly the treatment would have to be done by the Department for the first year or so or again it is not beyond the range of

possibilities that a firm would be prepared to lease a forest for the purpose of extracting the sleepers. Whatever it is decided to do in order to start the business a large profit at first obtained from such an undertaking cannot be expected though the future possibilities are very considerable.

As to the species of timber which might be utilized probably the *Dipterocarps* of Burma, the Andamans and Assam present the widest scope, the pines such as "Chir" and "Kail," especially the latter, would also answer the purpose, then again *Terminalia tomentosa, Lagerstrœmia myriocarpa* and *Lagerstrœmia microcarpa*, where found in sufficient quantities, might be tried, and many other species of more local importance. As regards the process of treatment, anyhow to begin with, an oil is advocated, such as Green Oil, *Avenarius Carbolineum*, or either of the two mixed with 50 per cent of earth oil in order to reduce their price. We know too little about salts or salts and oils combined to make it safe to experiment in this connection on a large scale, for failure in this direction would throw matters back seriously or entirely ruin the enterprise.

The writer believes this subject to be one very well worth considering and hopes that it will be brought under further discussion, as an opportunity such as is now presented will be for ever lost, if the Railway Engineers are again forced to take to iron ties.

R. S. PEARSON,
I.F.S.

THE TALLEST TEAK TREE IN THE "SHOLA" FOREST OF THE SOUTH MALABAR DISTRICT.

It is generally known that Teak, which is such a great light demander, is sometimes found in the dense evergreen forests of Burma and it there attains a gigantic height. But there is, as far as I am able to gather, no definite information regarding the height measurements of the tallest tree yet observed in Burma. The only information available on this head is, I think, in Gamble's "Manual of Indian Timber Trees" where trees are recorded

with a straight trunk of some 90 feet up to the first branch and a girth up to 25 feet. In Jackson's Manual of Sylviculture the full height of a large Teak tree is stated to be about 140 feet.

2. While in camp with the students of the Madras Forest College in the interesting Teak Plantations in the Nilambur valley, I was agreeably surprised to hear from the Forest Ranger at Nedangayam of the existence in the natural forests of that range, of a magnificent and gigantic Teak whose dimensions are hard to beat. I therefore decided to take a holiday excursion to see and measure this tree though the pest of leeches on the way and the long distance of about 26 miles to be tramped to and fro with the usual discomfort of a trip in the threatening rainy weather tempted me to avoid rather than seek it.

3. The way to Edakutti forests, where the tree is, is along the Karumpoya valley in the reserved forest of that name. The start was made from my camp at about 6 A.M. on a Sunday and after going down 3 miles on the forest road through the Teak Plantations, I was in the midst of a magnificent natural forest which among others contained an excellent crop of towering trees of Rosewood, *Xylia xylocarpa* and *Terminalia paniculata* which made me sometimes reflect whether after all their destruction in view to their being replaced by an artificial plantation of Teak is not a great commercial speculation. The remaining distance is partly over a much neglected bridle-path, along the Karumpoya river and partly over an ill-defined and leech-frequented footpath until the "Shola" was reached, where, but for the presence on its outskirts of a few gigantic Rosewood and *Xylia* species of the evergreen forests have taken possession of the ground. Right in the midst of this "Shola" is found the solitary well grown Teak tree not far off from the river. I felt rather disappointed when I found that the girth of the tree was not very extraordinary, but I felt amply rewarded for my trip when I made out that its height was greater than the tallest tree yet recorded.

4. The full height of the tree is 192 feet and the height of clean straight trunk up to the first branch is 114 feet. The girth at base is 16 feet 8 inches and at 4½ feet above ground 15 feet

10 inches. The tree appears to be pretty sound but there are signs of its deterioration. It is high time that it is extracted for timber, as a few hundreds of rupees which can now be realised from it might otherwise be lost to Government.

5. While on the subject of Teak in the evergreen forest, I was led to reflect on the past history of this forest when the tree was but a seedling perhaps 200 or more years ago. When it is recognised that dense shade that is always present in an evergreen forest cannot favour the springing up of young Teak, it can, I think, with every reason be inferred that the character and composition of the crop in the locality must have been entirely different some two centuries ago. What at present is a "Shola" was probably then composed of species typical of a deciduous mixed forest containing Teak, and with the absence of fires due perhaps to the large rainfall obtaining here (150 inches) and with the availability of timber trees in more accessible places nearer to the centres of consumption—a circumstance which must have in no small measure saved this part of the forest from the axe—the character of the soil, far from undergoing any deterioration, must have gradually improved with the annually increasing deposits of humus until the time came for the faster growing and dense shade giving species, typical of the evergreen forests, to take possession of the ground. Once these species appeared on the area, their direct effect on the already existing Teak must have been very beneficial in forcing the tree up towards light and keep it clean of its side branches. This probably accounts for the great height to which the tree in this locality has grown, and it is obvious that once the evergreen trees have taken possession of the ground any natural reproduction of Teak was impossible on the area and the species has therefore disappeared finally.

6. The "Shola" shows signs of steady extension and its further spread will doubtless assist in securing a more permanent flow of water in the river in the valley below.

MADRAS FOREST COLLEGE: K. R. VENKATRAMANA IYER.
11th December 1912.

THE BAMBOO FORESTS OF THE PEGU FOREST DIVISION AND THE METHOD OF EXTRACTION.

The chief forests in the Pegu Forest Division may be said to be within the basins of the Pegu river and Pazundaung creek, which two waterways meet near Syriam and enter the Rangoon river there. The forest reserves are situated on both sides of the upper portions of these two streams and are to be found on hilly broken country not favourable for permanent cultivation. These forests contain a great variety of bamboos, some species of which cover extensive areas. There may be found the *wabo* (*Dendrocalamus giganteus*) with its large towering culms, the *wanet* (*Gigantochloa macrostachya*), the *kyathaung* (*Bambusa polymorpha*), the *thaikwa* (*Bambusa Tulda*), the *myinwa* (*Dendrocalamus strictus*), the young tender shoots of which are eaten, the *kyakatwa* (*Bambusa arundinacea*) forming with its thorny culms formidable congested clumps, the *tiyowa* (*Thyrsostachys siamensis*), the *wagok* (*Oxytenanthera albociliata*), the *talagu* (*Dendrocalamus longispathus*), the *wayay* (*Dendrocalamus membranaceus*), the *wathabut* (*Teinostachyum Helferi*), with its long intertwining culms forming impenetrable masses of growth, the *tinwa* (*Cephalostachyum pergracile*) and the *wanway* (*Dinochloa M'Clellandii*) forming a growth almost as dense as the *wathabut*. Of these bamboos the *kyathaung* and the *tinwa* are the most common and are generally found associated with teak and pyinkado, growing in deciduous forests on well drained loamy soils. As a contrast to them, the *wathabut* and *wanway* are to be found forming congested masses of undergrowth in evergreen or partly evergreen forests, and growing on damp clayey soils. Such forests are very common along the upper reaches of the Pazundaung creek. The remaining species occur sporadically in different localities.

Bamboos are used very largely in Burma for various purposes. Give a Burman a *dah* and place him in a bamboo forest and he will work wonders. He will build his house out of bamboo, he will cook his food in a bamboo, his water-pots will be bits of bamboo, he will eat the tender shoots of the bamboo, his ropes, his mats, his baskets, his ploughing machines, his fishing implements,

his carts, will all be made almost entirely of bamboo. In fact to the village Burman the bamboo is one of the chief necessaries of life, and he has been blessed with an unlimited supply in the Pegu Forest Division. When the writer fresh from India first visited one of the reserves in the Pegu Division and from a convenient place of vantage saw the *kyathaung* and *tinwa* bamboo forests stretching out before him, clothing every hill and filling every valley, as far as his eye could reach, with a dark green mantle, he was struck with the immense gregariousness of the bamboo plant in Burma and his mind instantaneously reverted to the bamboo forests in parts of the Saharanpur Siwaliks near Dehra Dun. Those forests which consisted generally of miserable congested clumps usually with bent and crooked culms have had working-plans made for them and rules laid down not only regarding the method of cutting but also regulating the number of bamboos to be cut. What a contrast to the bamboo forest of Burma where people are allowed to cut as many bamboos as they like and can cut them where they like and how they like, as long as they take out the required licenses for the amount of bamboos cut. An enormous number of bamboos is cut yearly in the Pegu Division and yet it has no appreciable effect on the portions worked over. Young shoots more than equal to the number cut spring up by the time the next working season comes round. The working season for bamboos is chiefly during the rains from July to November. In the reserves bordering along the Pegu river bamboo cutting is in progress almost throughout the year, operations being only suspended according to rules during the fire-season from the 15th January to 15th June. In the reserves along the Pazundaung creek bamboos are extracted only during the rains, as during the other months there is not sufficient water to enable the bamboos to be floated down.

Bamboos are worked by bamboo traders who, after extracting the bamboos from the forests, raft them down to large villages and towns and sell them there. Comparatively few people extract bamboos solely for their own use, as they prefer buying them at their doors so to speak, to having to take the trouble to cut and

extract them themselves. The chief bamboos traded in the Pegu Division are as in other divisions in Burma, the *kyathaung* and the *tinwa*. A bamboo trader takes out a license for a large number of bamboos, say, 8,000. He gets one license for the whole amount together with as many blank licenses for 100 bamboos each as will make up the 8,000. In this case he would receive 80. He gives a certain number of the latter forms, after having filled in details, to each batch of his bamboo cutters. These forms are shown to any inspecting forest official who may chance to come round. The trader pays duty for these licenses at the rate of annas five per hundred or Rs. 3-2-0 per thousand. He then employs a certain number of bamboo cutters who do the cutting, dragging and raft-making for him. These men have to supply their own buffaloes. Armed with the licenses the bamboo cutters start off to their work. They generally go in batches of 5—10 men, some of whom bring their families to attend to the cooking. Two or three pairs of buffaloes of course are taken and invariably one or two decoy cocks or pheasants, while fishing nets may be found artfully concealed among the possessions of the cutters. There are recognised *sakans* (camps) situated on the banks of the river or of its large tributaries and at these places the cutters build new bamboo *tays* (huts) or repair those of the preceding year. Leading to these camping grounds are numerous well made dragging roads which form excellent inspection paths. After the huts have been erected or suitably repaired, both of which operations do not take the Burmans much time, the bamboo cutting commences. Most of the men of the party are engaged on this, leaving the women to cook, and the rest of the men to do the foraging by means of the decoy birds and fishing nets: the cutters generally break up into batches of three men each, two for the cutting and one for the dragging. They first select a fairly level spot on which are growing a fairly large number of bamboo clumps with straight culms and which is not very far away from the floating stream. They then clear a small space and erect a trestle thereon consisting of a stout bamboo about 6′ long placed horizontally about a foot from the ground on two bamboo struts firmly embedded

in the ground. A dragging path about 4′—6′ wide is then laid out and cleared until it meets one of the old paths. The bamboo cutting then commences. Straight healthy mature culms are selected and cut at various distances from the ground by means of sharp *dahs* (knives). The length of the bamboo cut, after the ends have been trimmed, varies greatly, but a good average may be taken at 20 feet. At less than a foot from one end, generally the stouter one, 2 notches about an inch long are cut into the bamboo side by side about an inch apart. These form the miniature drag hole or "napah" of the bamboo. When five bamboos have been so finished, a slender strip of bamboo about 18 ins. to 2ft. long is then driven through the five napahs placed side by side. The five bamboos are thus held together securely, and at the same time about 2ins. of the bamboo strip is left stretching out on either side. This lot is then placed on the trestle and another lot is made in the same way. When four such lots have been made in the case of the *kyathaung* bamboo or five in the case of the *tinwa*, the joined ends are placed one over another and securely fastened together into the bundle by means of thin strips (called *hnees*) of bamboo or cane. It will thus be seen that in each such bundle there are either 20 *kyathaung* or 25 *tinwa* bamboos, and that they are fastened securely at one end only, the other end being entirely free. When two such bundles are ready they are placed on the trestle one over the other, the fastened ends coinciding, and are lashed on to each other by means of split canes. A pair of buffaloes harnessed to a rough yoke of wood is then driven to the cutting place, and the large bundle of 40—50 bamboos is hitched on to the middle of the yoke between the two buffaloes by means of a thick iron chain passed twice around the fastened ends just behind the projecting bamboo slips. The unfastened ends remain trailing on the ground and the driver takes his stand upon them and starts the buffaloes off. The animals he guides by means of two bits of string only, and the way he controls them is marvellous. Up ridges, down valleys, skirting the edges of precipitous slopes, round sharp corners he drives his buffaloes like a modern Ben Hur, in a most fearless and dexterous manner, and at the

same time deftly balances himself on the trailing ends of the bamboos. Every now and then to encourage the animals he breaks out in a "Hah kyway" (here buffalo) and when he gets annoyed with them hurls forth at them blood-curdling unmentionable curses, which they do not pay the slightest heed to. Occasionally he bursts out in snatches of some wild song which too do not awaken any emotion on the part of the buffaloes. Thus amidst exhortation, curses and songs the bamboos are taken to the river or *chaung* near the place on which the camp is situated and there the bundles are dumped down into the water and the buffaloes are driven back to the cutting place for a fresh supply. When a sufficiency of bundles has been gathered in the water, each bundle of 20 *kyathaung* or 25 *tinwa* is securely fastened together at both the ends and the middle by means of split canes. Sixteen such bundles are placed side by side in the water and are fastened to one another by means of three strong poles (called *hmyaws*) placed crosswise two at the ends and one in the middle. To these poles the bamboos below are lashed very firmly by split canes. Over this layer of 16 bundles 14 similar bundles are placed in a parallel position and firmly attached to the layer below as well as to three poles placed crosswise upon them. These 30 bundles form one section of the raft, and it will thus be seen that it contains from 600—750 bamboos. Bamboos float down lengthwise and 5—10 sections like the one described above are joined end to end by means of canes and form a raft. Throughout the length of the last one or two sections are attached on both sides of the raft two pieces over 100ft. in length of the stout Yamata cane (*Calamus latifolius*).

These are required for anchoring the raft to the shore and are extremely useful as they are very strong. One or two small huts for the raftsmen and their families, if any, are then built on the raft. Generally four men accompany a raft of 6,000 bamboos. Where the water is shallow the raft is propelled along by poling, but where the river deepens and there is a sufficiently strong current the raft is allowed to drift down being guided only by means of 2—4 oars, placed some in front and some at the back of the raft. Each oar

is made out of a long stout bamboo to which is attached a number of split bamboos forming the blade. The above method is resorted to only in the rainy season when the water is fairly deep but in the cold and hot weathers when the water gets shallow, lighter rafts have to be made. They are then only constructed of two or three layers of single bamboos fastened in the same way as in the rainy season. The sections are much smaller in width and there are fewer sections in each raft. For a good part of the way the raft has often to be towed. On the Pegu river the licenses are checked at Zaungtoo, the first large village after coming out of the reserves. The time taken to reach that village depends on its distance from the place of felling and the amount of water in the river at the time. From Zaungtoo to Pegu, a distance of about 45 miles, rafts take 2—4 days to float down during the rainy season and about a month during the hot weather. The bamboo trader has to pay the following rates :—For cutting and dragging 1,000 bamboos Rs. 41 for *kyathaung* and Rs. 27 for *tinwa*. (A man can cut on an average 60 *kyathaung* and 100 *tinwa* in a day.) For constructing the raft he pays Rs. 5 and Rs. 4 per 1,000 bamboos for *kyathaung* and *tinwa* respectively, but the men who do this work have to bear the cost of the poles or *hmyaws* at Re. 1 per hundred, the canes over 75 ft. in length at annas four each and the split canes at annas two per hundred. For rafting the bamboos to Pegu it costs Rs. 6 per man ; a raft therefore of 600 bamboos controlled by four men would cost Rs. 24 for the floating charges. It will thus be seen that the cost to the trader will amount to Rs. 54 for 1,000 *kyathaung* and Rs. 38 for 1,000 *tinwa* bamboos. The selling rates at Pegu for these species of bamboos are Rs. 60 and Rs. 43 respectively per thousand. Landed at Rangoon the cost for bamboos brought down either the Pegu river or Pazundaung creek would be about Rs. 60 and Rs. 45 for *kyathaung* and *tinwa* respectively.

The bamboo forests of Pegu are being worked very very lightly and in the writer's opinion a bamboo pulp mill established in the neighbourhood of Rangoon would be very advantageous both to Government and to the pulp manufacturer. Syriam would be an

ideal place for such a factory. Land is comparatively cheap there, the pulp can be conveyed cheaply and quickly to the steamers and an almost unlimited supply of bamboos is available, which can very easily and cheaply be brought down by water transport from the forests. The different uses to which wood-pulp is now being put are extraordinary. Besides being used extensively for paper, wood-pulp is now being utilised in France and Germany to make pneumatic tyres which are said to be very strong, elastic, noiseless, waterproof and cheap. In Germany, too, an American engineer is turning out very cheaply from wood-pulp, articles which have been made hitherto from wood such as boxes, barrels and furniture, and from glass or earthenware. such as bottles and jars. In the same country, too, excellent synthetic jute is being produced at a minimum cost from wood-pulp and in France that material has been successfully used in the manufacture of rails. It will thus be seen that there is a vast demand for wood-pulp and this demand is increasing and will continue to increase by leaps and bounds. The chief sources of supply have hitherto been America and ports of Europe, but the forests in those countries cannot stand the strain of satisfying such heavy demands any longer. To India and Burma the wood-pulp manufacturer will now have to turn his attention if he wants forests and enormous supplies. Burma on account of its vast bamboo forests and extensive *kaing* grass lands offers a wide field to the pulp manufacturer and, as stated above, in the writer's opinion a factory established at Syriam would be a certain commercial success.

The Forest Department will only be too glad to get rid of their bamboos not only on account of the additional revenue brought in thereby, but also for a more potent reason. Even to an inexperienced eye like that of the writer's, it is evident on entering a teak forest that the bamboos, forming a dense complete canopy with their interlaced culms, are choking the reproduction of teak and pyinkado and thus ruining the crop of the future. This can further be proved by watching the luxuriant young growth of teak and pyinkado in places where bamboo cutting has taken place and the overhead cover has in consequence been interrupted.

It is therefore in the interest of the Forest Department to get rid of the bamboos in any way that it can.

A. J. BUTTERWICK,
E. A. C. Forests, Pegu Division.

FORESTRY IN TRINIDAD.

PAST TIMES.

In old times forests were considered an encumbrance to be got rid of as soon as possible in order to make room for crops for the sustenance of man. The early clearings being small, in comparison with the total forest area of any country, produced no visible harmful effect. The result was that the forests were indiscriminately cleared until the damage done became so plain that a demand for conservation arose. Naturally the effects of the destruction of forests was not apparent till many years after the clearances had been made and probably the results were at first attributed to other causes. The first areas cleared were allowed to revert to forest, after a few crops had been grown, and no great harm was done. Gradually, however, the clearances became larger and more permanent with the increase of population and better methods of cultivation and the areas denuded spread over considerable tracts of country before the result became noticeable and streams that formerly were permanent became intermittent. Droughts and floods succeeded one another, increasing in intensity until they could no longer be ignored. Comparison of denuded areas with those where forests still remained, followed, and in course of time the real effects of forests were understood. Timber, too, became scarce in localities where population was dense and had to be brought from considerable distances. The increase of transport facilities at first rendered this of little consequence especially while there were large tracts of country where the forests were still considered an encumbrance. The inconvenience became greater as the areas from which timber could be obtained decreased and in time a demand arose for the cultivation of timber as a crop as well as for the reservation of forests for the protection

of watersupply. In many cases of course both those objects could be obtained on the same areas and more especially in the more populous parts of the world. Consequently it was in these that forestry was first developed and to which we must look for guidance. Fortunately for Trinidad the destruction of forests had not become very serious before attention was drawn to the need for Conservation; the experience of older countries being then available for guidance in the methods to be adopted. In the western part of Trinidad and the south-western part of Tobago clearance has gone further than is desirable, and the reduction of the permanent supply of water in the rivers is already causing some inconvenience.

Up to 1890 Forest Conservation had not really been attempted though attention had been called to the matter by the Sub-Intendant of Crown Lands (Mr. now Sir David Wilson) as far back as 1880. Before that regulations controlling the cutting of timber under licenses had been in force but nothing had been done to replace the trees cut.

In 1891 in response to a despatch from the Secretary of State for the Colonies a report on "Forest Conservancy in Trinidad" was drawn up by the late Mr. J. H. Hart, Superintendent of the Royal Botanic Gardens, Trinidad (Tobago being at that time under a separate Government), in which it was stated that a permanent scheme of forest conservation was urgently demanded for the benefit of the island, that Forest reserves were needed for the protection of water supply and the growing of timber, and that denuded areas should be re-afforested and that though these measures were likely to be unpopular their adoption was becoming urgent. No definite proposals were made for Forest Reservations but reference to authorities in England was recommended, who, it was suggested, might draw up a scheme to be adopted and carried out by the Colony. Regret was also expressed that Mr. Hooper, an officer of the Indian Forest Department, who reported on other West Indian Colonies some five years previously, had not been invited to visit and report on Trinidad while he was in the West Indies.

Nothing further appears to have been done till 1900 when Mr. F. A. Lodge of the Indian Forest Department at the request of the Government visited and reported on "Forest Conservancy" in Trinidad and Tobago. Mr. Lodge's report published in Council Paper No. 62 of 1900 included definite recommendations for the reservations of 293 square miles or 16·74 per cent of the area of Trinidad as Forest reserves and 3·9 square miles or 12 per cent of Tobago, where, at any rate on paper, a considerable reserve already existed.

In the following year (1901) an officer from the Provincial Branch of the Indian Forest Department having eight years' service was appointed Forest Officer. He arrived in July 1901, and still holds the appointment.

Obviously the first work to be undertaken was the demarcation of the Forest Reserves proposed in the report of 1900. These proposals had not however been accepted in their entirety by the Government. The Reserves were considered larger than the necessities of the Colony demanded. This was a natural attitude to be taken by those not versed in Forestry and whose interest lay in the rapid extension of cultivation. It was thought that too great an area of good land has been included in the reserves while much poor land not fit for cultivation might have been taken instead. Eventually it was decided to reduce the area of the Forest Reserve in the mountainous northern part of Trinidad so as to include only land situated over 1,000 to 1,200 feet above sea level in the valleys running into the mountains and over 800 to 900 on the ridges and spurs, thus leaving out of the reserve the land most suitable for cultivation and allowing for the extension of agricultural settlements. This principle could not however be applied to the other reserves as the ground on which they were situated did not contain hills of sufficient continuity or elevation. It was therefore decided to lay out the remaining reserves substantially as proposed in the report of 1900 and when demarcation was completed to examine them carefully and select the areas necessary as final reservations and open the remainder to settlement. These preliminaries having been settled demarcation actually began in 1902-3.

DEMARCATION.

The Reserves in localities where the demand for land was most urgent were demarcated first, and as each reserve was laid out the surrounding land became available for settlement. The Reserves with the exception of the eastern part of the Northern Range Reserve were surveyed as they were demarcated. As demarcation proceeded and the demand for the land became less pressing, it became possible to select some final reservations in place of the proposals of the 1900 report, and thus at least in some places the cost of doing the work of demarcation twice over was avoided. While the work was going on considerable knowledge of the topography of the Island was obtained and the necessity for some additional reserves became apparent. It was not however intended to increase the total area of the reserved forest as the eventual reduction of some of the reserves proposed in the report of 1900 would open to settlement more land than was included in the new reserves. It was evident that the selection and demarcation of these new reserves was a pressing necessity if the opportunity for setting them aside was not to be lost by alienation from the Crown. The demand for agricultural land was not yet satisfied and in fact had been increased by the prospect of railway extensions and also by the increased interest in the prospects of petroleum. Consequently it became necessary to lay out the new reserves before the reduction of the older ones was proceeded with. These new reserves consist of belts about one mile wide along important watersheds and for the most part lie in the poorly watered southern part of Trinidad. They are designed to protect the supply of water in the upper parts of streams taking their rise in the ridges forming the watersheds. The hills forming the ridges being of small elevation, the work of tracing them through the dense evergreen forests where an outlook of any extent is unobtainable was a matter of no small difficulty. Incidentally while they were being traced more than one hill suitable for a Trigonometrical Survey Station was found, and topographical information not recorded on existing maps, though of considerable value in connection with future road construction, was obtained and

furnished to the proper authorities. The whole of these additional reserves has not yet been selected and demarcated and we may be said to be still in the period of demarcation. The following shows the present state of the work of demarcation (to March 31st, 1911):—

Name of Reserve.	Estimated area in Lodge's report of 1900.	Actual area by survey.	Length of boundary lines.	Gain or Loss.	
	Sq. miles.	Sq. miles.	Miles.	Sq. miles.	Sq. miles.
Northern Range ...	100	* 60	† 167	...	40·00
Central Range ...	76	62·04	54	...	13·96
Morn L'Enfer... ...	16	17·47	17·75	1·47	...
Cat's Hill	30	31·98	24·25	1·98	...
Trinity Hills	22	26·28	21·75	4·28	...
Arima	3	2·86	18·00	...	·14
Tumpuna	8	8·38	13·50	·38	...
Wind Belt	11	8·88	24·50	...	2·12
Siparia now Southern watershed.	8	17·49	35·75	9·49	...
Erin	‡	8·18	19·25	8·18	...
Mayaro	‡	12·50	29·25	12·50	...
Total Trinidad ...	274	256·56	425·00	38·28	56·22
,, Tobago ...	4	10·01	26 88	6·01	...
Total Trinidad and Tobago	278	266·57	451·88	44·59	56·22

The Caroni, Oropuche and Nariva Mangrove Swamp Reserves comprising 19 square miles have not yet been demarcated.

During the nine years since the appointment of a Forest Officer 266 square miles of reserved forest having a total of 452 miles of boundary line have been demarcated. The marks used to define the boundaries consist of cuttings of Dracaena or "rayos" at frequent intervals along the boundary lines, of concrete blocks or monuments some six inches square by eighteen to twenty-four

* Demarcation not completed. † Estimate not surveyed

‡ New reserves not included in Mr. Lodge's report.

inches long, of which twelve to fifteen inches is under ground marked C L. together with serial numbers, or bottles or stones set in the ground at angles in the boundary lines, and in addition, of trees blazed and stamped E.R 19 and enamelled iron sign plates bearing the inscription GOVERNMENT RESERVED FOREST fixed to trees adjacent to the actual lines. The boundary traces are cleared at intervals to a width of ten feet to render the boundaries clearly visible.

In forests like those of Trinidad and Tobago, where as a rule only 5 to 10 per cent. of the species are marketable, the improvement of the forest reserves in order to render them in a greater degree revenue producing is a matter of great importance. This question was given careful consideration while demarcation was proceeding. The species in greatest demand both for local use and for export were studied and the localities best adapted to their successful growth noted.

CHIEF TIMBER TREES.

The following is a list of the principal timber trees taken with a few necessary alterations in nomenclature from a paper by the Forest Officer read at the Victoria Institute in 1903.

"Cedar—*Cedrela odorata*, L., known in Europe as West Indian Cedar. A large tree 60 to 80 feet high, 4 to 6 feet diameter; wood a red or brown colour, splits easily, soft and porous, has a strong scent, and for this last reason is much used for wardrobes and such like articles of furniture; weighs about 36 lbs. per cubic foot; crushing strength 2·94 tons per square inch. It is much used for boards and furniture, and is exported to Europe for cigar boxes. It grows singly or in small groups, preferring sloping ground. The easily accessible forests which contain cedar in Trinidad are nearly worked out."

"Balata or Bullet wood—*Mimusops globosa*, Gaertn. A large tree 80 to 100 feet high, 4 to 6 feet diameter; wood dark red; dense, heavy, hard, very durable; weighs 70 lb. per cubic foot; crushing strength 4·77 tons per square inch. It is eminently suited for posts, bridges, and all kinds of outdoor work; it is much used by wheel-wrights and for railway sleepers, and requires to be seasoned in the shade, and is not attacked by wood ants. Value, £10 per ton. Grows singly or in small groups, preferring ridges or sloping ground; is not particular as to soil. The supply of this tree has been much reduced by tapping or bleeding for its gum, which is intermediate in character between rubber and gutta-percha."

"Poui—*Tecoma serratifolia*, Don. A tree 40 to 60 feet high, 1½ to 2½ feet in diameter; wood grey or green, hard, heavy, very durable; weighs about 70 lbs. per cubic foot. It is the best wood in the Colony for posts and all kinds of out-door work, and grows in a mixed forest, forming only a small proportion of the growing stock. Value, £10 per ton."

"Locust—*Hymenæa Courbaril*, L. A large tree, 60 to 80 feet high, 2 to 4 feet diameter; wood of a reddish brown colour, streaked, close-grained, hard and tough; weighs 69 lbs. per cubic foot; crushing strength 5·17 tons per square inch, it will not last in the ground but is suitable for wheel-wright work. Value, £10 per ton."

"Purple-heart—*Peltogyne porphyrocardia*, Gr. A large tree, 50 to 80 feet high, 1½ to 3 feet in diameter; wood of a dark purple colour, hard, heavy, close-grained, tough and durable; suitable for furniture, cabinet work and buildings, but rather difficult to work."

"Crappo or Carapa—*Carpa guianensis*, Aubl. A tree 40 to 60 feet high, 1½ to 3 feet diameter; wood reddish in colour, liable to warp if used unseasoned, weighs 42 lb. per cubic foot, durable, easily worked and suitable for furniture and building; is plentiful in mixed forests. Value, £8 per ton."

"Black Olivier—*Terminalia Buceras*, Wright. A tree 40 to 60 feet high, 2 to 4 feet diameter; wood durable, especially in water

or damp situations; used for boards, planks, posts, etc.; grows quickly and is fairly common."

"Mora—*Dimorphandra Mora*, Schomb. A large tree 80 to 120 feet high, 2 to 5 feet diameter; wood a chestnut-brown colour, hard, heavy, tough, strong, close-grained, very durable in water or damp situations; weighs about 65 lbs. per cubic foot; suitable for boards, scantlings and especially for large beams; is one of the first class woods at Lloyds, grows gregariously on low lying land subject to inundations and does well on poor soil. Trees over 4 feet in diameter are often unsound."

"Acoma—*Sideroxylon Mastichodendron*, Jacq. A large tree 50 to 80 feet high, 2 to 3 feet diameter; wood chestnut or brown colour, dense, heavy, hard, durable; weighs 66 lbs. per cubic foot; used for posts, frames of buildings and outdoor work."

"Watercaire or Aquatapana—*Lecythis lævifolia*, Gr. A large tree 60 to 80 feet high, 2 to 3 feet diameter, wood durable; used for posts and outdoor work; lasts well under ground. Value, £8 per ton."

"Cyp—*Cordia gerascanthus*, Jacq. A tree 40 to 50 feet high, 2 to 3 feet diameter; wood light brown colour, of medium hardness, tough, easily worked; weighs 38 lbs. per cubic foot; used for joinery, furniture, and cabinet work, suitable for carriage building and house construction."

"Balsam—*Copaifera officinalis*, L. A large tree 40 to 60 feet high, 2 to 3 feet diameter; wood dark-reddish brown, finely marked, used for repairs to railway carriages, suitable for furniture and cabinet work, easily worked."

"Roble—*Platymiscium polystachyum*, Benth. A tree 30 to 40 feet high, 1½ to 2 feet diameter; wood reddish-brown, hard and durable; suitable for out-door work, cabinet work and furniture."

"Fustic—*Chlorophora tinctoria*, Gandich. A small tree 20 to 40 feet high, 1 to 2 feet diameter; wood weighs about 44 lbs. per cubic foot; is used by wheel-wrights, and yields a yellow dye, for which it is exported. Value, £3 to £5 per ton."

PLANTATION WORK.

Though it was realised that improvement fellings would probably in the end yield better results for the expenditure incurred than the establishment of plantations, certain circumstances favoured the adoption of the latter method of increasing the value of the Forest Reserves. It will be readily understood that while demarcation was being actively pushed on and resources were limited, it was impossible to give much attention to plantation work that improvement fellings had to be left to a later date, and that the preparation of "working-plans" for the reserves was altogether out of the question. In fact it was not till 1908 that plantation work even on the smallest scale could be attempted. In that year it was decided to devote a small portion of available funds to plantation work at the cost of a somewhat reduced rate of demarcation. An area was therefore selected in the cedar forest within the Southern Watershed Reserve, about one and a half miles from the south coast of Trinidad, for a cedar plantation. Ten acres of forest, containing two cedar trees, and three stumps of previously worked trees were felled and lined out twenty feet by ten feet. The area was not burnt as is usually done in preparing land for cacao. The rows were laid out north and south, at right angles to the prevailing wind, and a few small trees such as could subsequently be removed without injury to the young crop were left as temporary shade. As no forest nursery existed and the cost of transport of plants from the Botanic Gardens in Port-of-Spain (40 miles by rail, 15 by cart-road and 6 miles by foot-track) was prohibitive, it was only found possible to plant five acres with seedings collected from the adjoining forest during the year 1907-08. In the following July cedar seeds obtained from a specially selected tree of a good type for producing timber were sown. In each subsequent year a further ten acre block has been felled and planted with cedar. Seeds were sown at pickets in June and July, transplants being used as supplies later on as required. Some damage has been done to the young cedar by a twig borer that destroys the leading shoots causing

some loss of growth. Fortunately natural enemies are keeping this pest in check. In addition to the cedar plantation an area of 25¾ acres in the Arima Reserve in the lower slopes of the Northern Range has been planted with cyp (*Cordia gerascanthus*, Jacq.), mahogany (*Swietenia Mahagoni*) and a few *Hevea brasiliensis*. This plantation was started in 1908 with 250 cyp and 150 mahogany on 1¾ acres, to which was added 2 acres in cyp and Honduras mahogany as well as 22 acres in cyp with a few *Hevea brasiliensis* in 1910-11, the latter area having been treated to a seeding felling in the previous year.

In the Central range Reserve, too, 20 acres of forest containing nothing of value was felled lined out 20 ft. by 10 ft. in 1910-11; of this 6·3 acres were planted with a mixture in groups of poui (*Tecoma serratifolia*, Don. *Hevea brasiliensis*) and Honduras mahogany, the remaining 13·7 acres being sown with cyp after the close of the financial year.

The total area of plantations at the end of the year 1910-11 stood at 85¼ acres and contained :—

8,720	Cedar.
5,065	Cyp.
502	Poui.
738	Honduras mahogany.
440	Hevea brasiliensis.
175	Mahogany.
15,640	

A further 50 acres is being planted in 1911-12 principally with cyp and cedar.

No plantation work has as yet been found possible in Tobago.

The following estimate of the cost of forming a cedar plantation of 100 acres on the lines above recorded, and the probable financial results may be of interest. The prices are fixed with regard to the wages current in Trinidad where estate labour costs 40 cents a day, and forest labour where the men have to sleep away from their homes, costs 60 cents a day.

ESTIMATE FOR A CEDAR PLANTATION OF 100 ACRES.

EXPENDITURE :—						
Felling 100 acres at $6 25 per acre		...	...	...		$625 00
Burning and fire traces $1 50 per acre		...	...	...		150 00
Stacking and burning logs $5 00 per acre ...			...	...		*50 000*
Preparing pickets	1 00 ,,	...	...	...		100 00
Lining out with pickets	2 25 ,,	...	...	...		225 00
Preparing planting holes	*6 00* ,,	...	...	...		*600 00*
Sowing	2 00 ,,	...	...	...		400 00
Nursery for supplies	...	...	...	...		600 00
		Total first year		...		3,000 00
2nd year cleaning and supplying		...	...	...		1,000 00
3rd ,, ,, ,, ...		...	...	...		900 00
4th ,, ,, ,, ...		...	...	...		700 00
5th ,, cleaning ...	...	...	...	...		500 00
6th ,, ,, ...		...	...	...		353 00
7th ,, ,, ...	...	...	...	...		300 00
8th, 9th and 10th years cleaning at $1 50 per acre			...	...		450 00
		Total second and tenth *year*		...		4,200 00
11th to 60th years maintenance at 48 cents per acre per annum				...		*2,400 00*
Grand Total	...	...	...	...	$	9,600 00
RECEIPTS :—						
Sale of thinnings in 30th to 40th year, 8,000 trees at $2 per tree				...	$	*16,000 00*
Final crop in 60th year, 10,000 trees at 65...			...	...		50,000 00
					$	*66,000 00*
PROFIT ...	...	...	...	...	$	56,000 00

Note.—As 21,600 trees would be planted, the above estimate allows for a loss of 3,600 from various causes.

C. S. ROGERS,
Forest Officer, Trinidad and Tobago.

INDIAN FOREST SERVICE PROBATIONERS.

The following memorandum regarding the Final Examination of Indian Forest Service probationers, 1913, is published for information :—

1. With a view to the allocation of the annual Currie Scholarship for Indian Forest Students (value about £35), and to facilitate the allotment of probationers to the several provinces in accordance with paragraph 12 of the Regulations as to appointments in the Indian Forest Service, probationers who have completed their prescribed course of training at the Universities will be required to undergo a competitive final examination in Forestry.

2. A list of the probationers in order of merit will be prepared by adding together (*a*) the marks obtained at the final examination, and (*b*) the marks obtained during the course of practical training in forestry under the control of the Director of Indian Forest Studies. The maximum of marks obtainable under (*a*) will be the same as under (*b*).

3. The final examination will consist of three papers, as follows :—

(*i*) A paper in Silviculture, Forest Protection (including Forest Botany and Forest Entomology), and Forest Utilisation (including Forest Engineering).

(*ii*) A paper in Forest Management, Forest Mensuration, Forest Valuation, and Forest Administration.

(*iii*) A paper in General Forestry (Practical) dealing with the work done and with the forests visited, during the course of practical training.

4. The final examination will be held at the beginning of October. Arrangements as to the date and place of examination will be made by the Director of Indian Forest Studies. Probationers will not be required to pay any fee for the examination.

TANNIN EXTRACTS.

The following circular has been addressed by the Government of India to Local Governments :—

"1. In order to turn to practical account the results so far achieved of the enquiries under the direction of the Inspector-General of Forests which have for some time past been conducted into the preparation of tannin extracts from products of Indian forests, and of the examination and analyses which have been made of various barks and fruits known to yield tannin, with a view to testing their commercial value, it has been decided to endeavour to obtain the services of an expert from England.

2. During the last few years the Forest Chemist has twice visited Rangoon to investigate the preparation of tannin extracts from mangrove bark at the Government Tannin Factory at that place, with the object of ascertaining why the extracts hitherto prepared there were of a bad colour and consequently unsaleable. He also enquired into the probable commercial prospects of the manufacture of tannin extract in Burma, whether from mangrove or from other barks, or tannin yielding forest products, of which large quantities are known to exist. The results of his enquiries though giving good promise of future success convince the Government of India that before a profitable industry can be established it is necessary that the subject should be thoroughly examined by a professional tanning expert with a practical experience in the manufacture of extracts. His Majesty's Secretary of State for India has accordingly been asked to select and send out to India such an expert. The expert selected, who will be engaged for a period of two years, will bring out such plant as he may consider necessary, capable of preparing not less than 2 cwt. of extract at a time and will prepare tannin extracts in sufficient quantity to allow of tests on a commercial scale. He will be required to examine barks and other tannin yielding raw materials at the Forest Research Institute at Dehra Dun or elsewhere, to visit the chief centres of production of the raw material, to study and report on local conditions, to give details of the cost of production, to advise as to the selection of sites for factories and the machinery

needed for their equipment, and generally to collect and report such information as is likely to attract capitalists.

3. With the object of utilising as fully as possible the services of this expert (*if his appointment is sanctioned*) on the lines indicated above, the Government of India will be glad to be informed at an early date what tannin yielding forest products $\frac{\text{the Government of ——}}{\text{you}}$ would wish examined at his hands, and whether $\frac{\text{they}}{\text{you}}$ would wish to avail $\frac{\text{themselves}}{\text{yourself}}$ of his knowledge to report on the possibility of the profitable preparation of tannin extracts locally, and if so, to what extent or for how long $\frac{\text{they}}{\text{you}}$ would desire to utilise his services."

NOTE ON TAPPING OF *BOSWELLIA SERRATA* TREES IN THE SIWALIK DIVISION, U. P.

1. *Previous experiments.*—Several attempts were made to tap *Boswellia serrata* in the hot weather of 1912. Most of the trees which have been tapped recently (December 1912) were tapped in May 1912, in three different ways, *i.e.*, (i) by cutting a large "V" into the bark down to the wood, (ii) by making cuts all over the bark with an axe (native method of tapping *Pterocarpus marsupium, Butea frondosa*, etc.), and (iii) by making a ring all round the tree to the wood and shaving the bark off below to a distance of about a foot (method employed in Gwalior and Kotah States). The results of these experiments were negative, no gum-resin being obtained. Mr. Billson, the Divisional Forest Officer, Siwaliks, very kindly undertook to have 500 trees of "Salai" tapped elsewhere in the Siwaliks in May 1912, the result was similar, no gum-resin being obtained. Some years ago similar experiments were carried out in the East Khandesh Division of the Bombay Presidency and more recently in Madras with the same result. However, it was known that both in the Gwalior and Kotah States the gum-resin was collected in commercial quantities, as the Conservator of Gwalior and the Superintendent of Forests, Kotah, had very kindly sent in full reports on the subject, describing the methods of tapping. The tapping in both the States is carried

out during the cold weather, so that it was decided to carry out further experiments in the Siwaliks during November and December 1912.

2. *Situation.*—The trees tapped are on an outer warm spur of the Siwaliks, on the south side. They are grouped round the top edge of the spur, few or no "Salai" trees being found lower down the slopes.

3. *Climate.*—Rainfall about 40 to 50 inches, temperature cold during the winter months from November to February and fairly hot during April, May and June.

4. *Present experiments.*—The number of trees tapped was 72 of which 52 were originally tapped in May 1912. The reason for tapping only 72 trees was that it was thought better to tap a few only in order to more carefully examine the behaviour of each individual tree. The majority were tapped by cutting a ring all round the tree down to the wood, with an adze, at breast height, about $\frac{1}{2}$ to $\frac{2}{3}$ of the bark was then shaven off below, the shaving being about one foot wide; a few trees had large "V" shaped incisions made on them and on a few a ring was cut round the tree and the bark shaved off from *above* the ring. The latter two methods proved a failure. The tools used for tapping were—a light adze, a razor-edged draw-knife with a 9-inch blade, putty-knife for collecting the gum-resin, a small short-handled American axe and a small bucket in which to collect the gum-resin. The adze, if properly handled, answers quite well, though perhaps a broad chisel and mallet would make it easier to cut a clean even circle. The draw-knife answered the purpose admirably but should have a 12″ or 14″ blade, so as to facilitate shaving the bark off trees of large girth. The putty-knife for collecting the gum-resin answered far better than a common knife. Provided the circular cut is made clean and the bark shaved off smoothly the gum-resin can be collected quickly and with very little loss.

After making the first cut the gum-resin was allowed to flow for four or five days, after which it was collected, and the cut freshened by cutting a fresh ring, *i.e.*, removing about half an inch of bark from above the original ring and with the draw-knife

freshening the bark 2 or 3 inches down the original cut band. In some cases the trees were freshened a second time after a further interval of four or five days and the gum collected. (See statement.) The experiment was then stopped.

5. *Results.*—In a few cases after making the first cut no gum-resin exuded, this was nearly always in the case of thin barked trees. In many cases a little gum resin appeared, in a few cases a comparatively large amount of gum-resin was collected. After freshening the wounds once in nearly every instance the gum-resin began to flow more freely, while a distinct improvement was again noticed with the second freshening. The amount of gum-resin obtained from each tree varied very considerably, old thick barked and faulty trees generally gave most gum-resin, while small coppice shoots also in some instances gave copious gum-resin. Generally speaking, the sunny side of the tree gave most gum-resin. As the gum was collected off each tree, a record was made as to the amount of flow (see statement), thus in the detailed record V. P. denoted very poor; P., poor; F., fair; G., good; and V. G., very good. So as to denote the average relative flow of gum-resin after making the 1st, 2nd and 3rd cuts, by counting V. P. as 1, P. as 2, F. as 3, G. as 4, and V. G. as 5 we obtain the following results :—

No. of trees tapped.	No. of points allotted to 1st cut.	No. of points allotted to 2nd cut.	No. of points allotted to 3rd cut.
25	75	86	94
72	192	251	...

From the above it will be seen that the flow of gum-resin improves after the 1st freshening and again after the 2nd freshening. The amount of gum-resin collected during the intermediate collections, *i.e.*, from 25 trees tapped once and freshened once and from

the remaining 47 trees tapped once, was 1 lb. 6 oz., while the final collection after the second freshening of 25 trees and the first freshening of 47 trees amounted to 1 lb. 11½ oz. The first trees were tapped on the 29th November and the last collection took place on the 12th December 1912. Only the first 25 trees had been brought into a proper condition for yielding gum, so that as far as figures of outturn are concerned, these are necessarily considerably below the average. The only figure of any importance in this connection is that of the last collection, when all trees were yielding gum, though probably not to their maximum capacity.

6. *Conclusions.*—It appears unnecessary to shave the bark off in the first instance, below the cut ring, lower than three or four inches. The present method of tapping cannot be by any means the best, further experiments are required to decide how it is best to carry out the work. All that the experiments show so far is that gum-resin of "Salai" can be tapped in this way. We have also to determine in what month of the year most gum-resin exudes from the tree, this will probably vary according to climate and locality. It is provisionally thought that two men can attend to 100 trees, but this will probably be found to be far below the mark. It is further thought that unskilled labour will be able to fully cope with the tapping of the trees. It is fairly certain that trees exude most gum-resin from old wounds. The time the wounds take to heel up, looking to old scars, will probably be found to be relatively short. It is thought that possibly gently hammering the bark above the cut may increase the flow of the gum-resin. The cost of collection cannot be even guessed at for the present. It will probably be above that of chir resin.

The details of tapping are given in the statements on pages 200—201. Any data or established facts on the tapping of *Boswellia* with details of amount of gum yielded will be welcomed by the Forest Economist, Dehra Dun.

R. S. PEARSON,
Forest Economist.

Tapping experiments at Ranipur, Siwalik Division, U. P.

No. of tree.	Date of tapping.	Date of 1st freshening and collection of gum.	Date of 2nd freshening and collection of gum.		Girth of tree.	REMARKS.
1	2	3	4	5	6	7
					ft. in.	
43	29-11-12P	30-11-12 P	9-12-12 F	Final collection made on 12th December 1912. Cuts not refreshed.	4 7	Cut circular 5 ft. up trees and bark shaved off all round for about a foot down. No gum exuded on first cut, it began to exude on second cut.
42	do. F	4-12-12 G	do. VG		5 2	
44	do. P	do. F	do. G		4 6	
45	do. F	do. G	do. G		4 7	
46	do P	do. F	do. F		4 8	
47	do F	do. F	do. G		5 10	
55	do. P	do. F	do. F		1 6	
56	do. F	do. G	do. F		1 8	
57	do. P	do. P	do. P		4 1	
58	do. P	do. F	do. F		3 7	
41	do. G	do. VP	do. VG		4 7	
59	30-11-12P	5-12-12 G	10-12-12 G		3 5	
60	do. G	do. VG	do. VG		3 2	
53	do. F	do. G	do. G		{4 6 4 0	
61	do. G	do. G	do. G		1 10	
62	do. P	do. G	do. F		2 2	
63	do. VG	do. VG	do. F		1 7	
52	do. G	do. G	do. VG		6 1	
51	do. VG	do. VG	do. VG		6 7	
48	do. P	do. P	do. F		4 5	Cut made at bottom instead of at top of cleared band.
49	do. P	do. P	do G		4 9	
50	do. P	do. P	do. P		4 4	
64	do. F	do F	do. F		4 1	
40	do. G	do. G	do. VG		5 7	
39	do. VG	do. VG	do. VG		7 2	An old tree giving more gum than any other.
65	2-12-12G	7-12-12VG	...		3 10	
66	do. F	do. VG	...		6 0	
67	do. VP	do. P	...		4 4	Tapped "V" shape.
68	do. F	do. VG	...		4 5	
69	do. F	do. G	...		4 8	
70	do. P	do. F	...		2 9	
38	do. G	do. G	...		{2 10 2 9	
37	do. P	do. F	...		4 5	
36	do. P	do. P	...		3 5	
2	do. P	do. P	...		3 10	

No. of tree.	Date of tapping.	Date of 1st freshening and collection of gum.	Date of 2nd freshening and collection of gum.		Girth of tree.	REMARKS.
1	2	3	4	5	6	7
3	2-12-12 P	7-12-12 VP		Final collection made on 12th December 1912. Cuts not refreshened.	4 4	
35	do. F	do. F			3 8	
34	do. P	do. P			3 8	
1	3-12-12 P	do. P			5 0	
32	do. G	do VG			5 6	
31	do. F	do. VG			3 4	
30	do. F	do. VG			4 0	
29	do G	do. G			4 10	
71	do. P	do. F			4 3	
28	do. P	do. F			3 9	
26	do. VG	do. VG			4 0	
25	do. G	do. VG			4 9	
24	do. G	do. G			5 0	
11	do. F	do. VG			4 7	
13	do. G	do. VG			13 6	
12	do. G	do. VG			2 5 4 5	
72	do. F	do. G			3 11	
4	4-12-12 F	9-12-12 G			4 9	
7	do. P	do P			3 2	
6	do. P	do. F			3 7	
73	do. P	do. F			2 10	
21	do. G	do. VG			2 1 3 3	
74	do. P	do. P			2 6	
20	do. G	do. VG			3 4	
19	do. VP	do. P			3 8	
5	do. P	do. F			3 5	
18	do. P	do F			5 6	
16	do. F	do. G			4 8	
17	do. G	do. VG			4 0	
9	do. G	do. G			3 4	
8	do. G	do. G			3 9	
14	5-12-12 G	10-12-12 VG			4 7	
22	do. VP	do. VP			4 9	
15	do. P	do. G			3 9	
23	do. VP	do. VP			4 5	
75	do. VP	do. VP			1 9 3 0	
10	do. F	do. F			2 11	

NOTE ON FUEL FLOATING IN THE HIMALAYAS.

In 1910 the Forest Department undertook to arrange for the fuel supply of Almora Settlement (U. P.), the requirement of which amounted to about 60,000 maunds per annum.

The most convenient forest for meeting this demand was found to be the Protected Forest of Airadeo, about 17 miles from Almora, situated on the banks of the Kosi river. The method of exploitation adopted has been shortly as follows :—

The wood (chir pine) is felled and split up into billets (18" by 6" diameter) and carried by coolies from the forest to the Kosi bank, an average distance about 2 miles. It is then floated down the river a distance of about 12 miles to a point called Hawalbag, situated on the Ranikhet-Almora cart-road, and from this point it is taken up in country bullock carts to Almora, a distance of 7½ miles. It is only the cheapness of the floating that makes it possible to deliver the fuel in Almora at a reasonably cheap rate, so a few remarks on this work may prove of interest.

The floating is started as soon as the rains cease, *e.g.*, about the beginning of October. We have learnt by bitter experience the dangers of floating in the monsoon. The first attempt at floating fuel was undertaken by the Civil Forest Authorities in August 1909. A big flood broke the boom and washed 18,000 maunds away.

In 1910 we started floating in September, and during that month safely landed about 10,000 maunds at the boom depôt. An unprecedented storm in October, which gave 25" of rain in 60 hours, caused such an exceptional flood that some of the fuel stacks in the depôt were washed away, and about 4,000 maunds were lost. During 1911 and 1912 however we have been quite successful, and have lost no wood at all. A certain amount of the wood however usually gets water-logged and sinks *en route*, but this quantity is well under 5 per cent. and much of it is recovered later when the floating work is finished.

It takes about two months to bring down the full quantity of 60,000 maunds, and the cost varies from Rs. 4 per 100 maunds in the beginning of October to Rs. 10 per 100 maunds in the end of

November. This difference is of course due to the gradual diminution of the water in the river, but it includes the cost of catching the fuel at the boom and stacking on the bank, a relatively large item.

Two booms are employed, an upper floating timber boom—a chain of logs threaded on to a strong wire hawser—and lower kachcha stone boom. The former is employed when there is a large quantity of water flowing, the latter is used from the end of October. It costs next to nothing to make, and works quite satisfactorily. This is well shown in Plate 2.

Needless to say if the river rose even one foot, a large proportion of the floating fuel seen in the photograph would be washed away. This however looks a bigger risk than it actually is, as floods and heavy rain after the middle of October are unheard of.

All the work in connection with this fuel supply, the cutting and carriage from the forest, the floating, and the carting to Almora, is done on contract, the contractors getting 8 annas per 100 lbs. of wood delivered in Almora, which is not a very excessive sum when one considers the risk and the work involved. As the local contractors do not possess much capital, and the outlay before the fuel reaches Almora is considerable, it is found necessary to finance the contractors by part payments as the work proceeds. Altogether the general arrangements work very satisfactorily.

The photograph was taken by Ranger Nathu Singh.

E. A. Smythies,
I.F.S.,
Divisional Forest Officer.

Naini Tal Division:
22nd December 1912.

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THE TRUE SELECTION SYSTEM.

In an article in the *Indian Forester* of August 1909, I suggested that in working-plans for areas under the Selection system, the most desirable mean girth of exploitation should be the determining factor for the prescriptions, instead of allowing the mean girth to be decided by the minimum girth and by an arbitrary fixing of the felling cycle. The whole argument was based on the practice in vogue of fixing a girth at which the trees become exploitable and insisting that no trees (except in subsidiary fellings) may be felled below that girth; thus necessitating, as is generally assumed, an accumulation of trees of greater girth than the minimum (generally called I class trees). It is this accumulation of I class trees which leads to the creation of a mean girth of exploitation distinct from the minimum girth of exploitation, a state of affairs which seems to be unscientific and I have lately been led to wonder why it has always been treated as a necessary part of the selection system.

It is unscientific for two reasons :—Firstly, 6 feet either is or is not the girth at which it is financially sound to fell Sál trees. Presumably it is a sound girth or it would not be chosen as the minimum and in that case it is unsound to make prescriptions which lead to a higher mean girth of exploitation. If on the other hand a 6 foot tree is in fact immature, it is not right that felling trees of this girth should be a permanent feature of working

plans. Secondly, the accumulation of I class trees leads to a proportion of the area being occupied by overmature trees with a consequent stagnation of capital.

In February 1912 Mr. Troup gave us a series of most useful formulæ for calculating the possibility of various *degrees of* this accumulation and I may quote a part of this article as apt to the present argument. He says: "This results in an accumulation of mature trees which have reached maturity in each coupe after the fellings have passed over it; this accumulation constitutes an excess of mature trees which has to be kept on the ground and may be regarded as so much working capital. The reduction of this excess to the minimum possible, so far as is compatible with practical working and simplicity, should be one of the chief aims in fixing the period and felling cycle." It is clear that Mr. Troup regards the accumulation as an evil but he evidently thinks it a necessary one.

Now under the Uniform system I have never seen it suggested that any such accumulation of mature trees is necessary. The rotation is fixed with the idea that such a number of years will produce trees of a desirable size and each age-class in theory occupies an equal area, no space being allotted to an overmature age-class. Having for example decided that a 6 ft. Sál tree is sufficiently large and that 120 years will produce such trees, it is not proposed to raise the rotation to 150 years in order that 6′ 9″ may be the average size of exploitation. This is what is done in fact in Selection system working-plans. On consideration it appears that it is the system of girth-classes which has led to this supposed necessity for an accumulation of I class trees. For example, say, the smallest II class Sál tree becomes I class in 30 years, then all the trees in the class will be I class in 30 years. The fellings have just taken place, all I class trees have been removed and in 30 years' time the coupe will be revisited. It appears to be assumed that the II class trees *must* range from 4′ 6″ to just under 6′ and that consequently in the course of the 30 years there must be an ever-increasing accumulation of I class trees and that it is a necessary part of the system. But it seems clear on the analogy

of the Uniform method that there is no necessity for the trees which will be felled after 30 years in the 2nd cycle to range from 4′ 6″ to just under 6′. They may be all 4′ 6″ and ideally they should be. For if the fellings which have just taken place give rise, as they should, to regeneration, that regeneration will eventually give rise to trees of the same age, and with proper thinnings, to trees of approximately equal size, *i.e.*, in 90 years there will be trees of approximately 4′ 6″ girth and not trees ranging over an 18″ girth class. It is therefore the 18″ girth-class which appears to have given rise to the fiction of an indispensable stock of trees from 6′ upwards to about 7′ 6″. What is wanted then is to arrange as far as possible that the ideal state should exist and not deliberately to plan an unnecessary accumulation of mature trees. In other words, our irregular forests are no more in a fit state for the Selection system than they are for the Uniform system and the initial step should be Transformation fellings for the one system just as much as for the other. In transformation to the Uniform system the most ruthless felling of even IV class trees is frankly advocated but hitherto any one who proposed to get a forest into order for Selection fellings by sacrificing his class II would have been scorned as a base revenue hunter. That however is undoubtedly the method by which the Selection system proper should be introduced. Instead of assuming that the I class trees now on the ground will be replaced in 30 years by the present II class, they should be replaced by trees having a mean girth at present of 4′ 6″. Nowadays the III class is in a very flourishing condition in most forests and in 30 years' time trees ranging now from 4′ to 5′ will be at least quite as numerous as the present I class. All trees over 5′ may therefore be felled at once. In 30 years' time the present 4′ to 5′ trees may be 5 6″ to 6′ 6″. Everything over 5′ 6″ will then be felled and in the 3rd cycle a minimum and mean girth of 6′ would be attained and sacrifices of immature trees would cease. The sacrifice would be nothing like that necessary for the uniform method and might under favourable circumstances be confined to the first cycle. Even for the present accumulation method of selection fellings some process of leading the forests

into the state necessary for success is essential, as any one who has tried to arrange equal annual outturns can surely vouch for. The usual method is to arrange for the necessary accumulation of I class on the area *as a whole*, divide it into fixed annual coupes, prescribe a maximum annual possibility and trust to luck. Now it is obvious that if an area is capable of producing 900 I class trees in 30 years and if the markings stop in each coupe when 30 I class trees have been marked, the inevitable excess over 30 I class trees in some coupes will be wasted and will not be available for the deficits in other coupes. Hence it has been proposed to have not fixed coupes and to go on marking each year until the 30 trees have been found. This however is not the solution of the difficulty that it at first sight appears to be. For let us assume that the accumulated I class trees which should be 450 with a 30-year transition period and felling cycle, are spread more or less equally over the area. The trees marked in coupe I must be all accumulated I class and 30 trees will be found by going over one-fifth of the area and at the end of half the cycle the felling will have extended over the greater part of the area and it would be necessary to go over most of it twice to get the annual possibility each year. This would entirely upset the practical working of the forests. The accumulation will of course attain its proper distribution for the 2nd cycle after one complete cycle *provided the same system of fellings is adhered to*, but to provide the accumulation as a total over the whole area is a useless shutting up of capital and a stumbling block to the working-plan. An inequality of outturn in the first cycle must be faced as necessary for equal outturns in the 2nd and there must be continuity of system.

Transformation fellings for the Selection system might however go much further than the introduction of a real—instead of a pseudo—girth of exploitation. They might extend to helping on a proper distribution of all the girth-classes over the area. For a forest cannot be properly worked by the Selection system unless the crop more or less fulfils the postulates of that system, namely, all sizes of trees scattered more or less equally

all over the area. It must of course first be definitely decided that the selection system is certainly the best for a particular type of forest before steps are taken to transform the crop into a state suitable for the true Selection system. It will then be time that some other name were invented for the system which has hitherto passed as Selection, in which nothing is done to reduce the irregularity of the stock and the only objects in view are equal annual outturns, the avoidance of over-felling and the improvement of the general quality of the crop.

F. F. R. CHANNER,
I.F.S.

NOTE ON THE TREATMENT OF SLEEPERS AT PYINMANA, BY THE FOREST ECONOMIST, IN JANUARY 1913.

1. The plant was the one used for treating sleepers in 1912, with *Avenarius carbolineum* oil. It consists of four iron tanks, two of which take 5 and two 6 M. G. sleepers each. They are embedded in masonry to within a couple of inches from the top and fitted with fire-places and flues running beneath them. They are laid parallel to each other about 8 feet apart from centre to centre. Running at right angles to them are two rails one at each end of the tanks, supported on posts about 3 feet 6 inches from the ground, on which slides a beam at right angle to the rails and therefore parallel to and above the tanks. It is fitted with flat iron plates and flanges at the bearing surfaces, and with two simple wooden pullies hung underneath, about 3 feet apart and over the tanks. To raise and lower a parcel of sleepers two ropes, one over each pully, are hooked to the chain round the sleepers, and as the parcel of sleepers is raised out of the tank, two small poles or bars are put at right angles across the tank and the parcel allowed to rest on them until it is broken up and the sleepers removed. In the same way the parcels of sleepers to be treated are made up over the tanks and, when ready, bound and lowered by the pullies into the solution. When the sleepers for one tank have been dealt with the bar is pushed over the next tank and the same operation repeated.

2. To save time and also expense, two wooden tanks lined with zinc sheeting and taking 11 sleepers each were prepared in which to treat the sleepers. They gave trouble at first by leaking, this was overcome by fitting them with a second lining of zinc. Though let into the ground, they had no flues. It was afterwards found that heat was absolutely necessary to cause sufficient penetration of the solution. To overcome this difficulty the sleepers were first heated in one of the smaller tanks and then quickly transferred to the larger ones, and allowed to cool down. This method, though increasing the amount of penetration by over 100 per cent, took time, so that the use of the larger tanks cannot be said to have been successful and cannot be recommended. In the case of the larger wooden tanks the method of loading was to erect a strong tripod over the tanks and by using differential pullies to hoist the sleepers in and out of the tanks—a very simple and effective method of working. The permanent plant consisting of the four small tanks fitted with masonry flues and a travelling bar and pullies is good. It could, however, be greatly improved by raising the bar 18 inches or 2 feet so as to enable one to use differential pullies, and by materially increasing the size of the tanks. It is quite easy with differential pullies to deal with 9 M. G. sleepers in one parcel, and to make the tank hold two such parcels, or 18 sleepers in all. For this purpose the iron tank should be 6 feet 4 inches long by 5 feet broad and 2 feet 8 inches deep; the bottom and sides being stiffened by three iron bars rivetted to them. The running bar has to be held in position over each tank, this is now done with two bamboo poles, it would be better to fix a clamp so as to hold it to the rail.

4. The 'In' and 'Kanyin' sleepers are not difficult to sink, this is done with an old iron rail. Where sleepers of lighter specific gravity have to be dealt with it may be possible to erect a special sinker. This will be tried when again treating Chir and Kail sleepers at Jagádhri.

5. The object aimed at was to treat 500 'In' (*Dipterocarpus tuberculatus*) and 500 'Kanyin' (*Dipterocarpus alatus*) M. G. sleepers by a mixed impregnation method, of which 700 M. G. sleepers

were to be treated with Chloride of Zinc and Green Oil and 300 with Atlas solution and Green Oil. The latter process was tried but owing to the poisonous nature of the solution which it was thought would render it dangerous to use on a large commercial scale, after treating about 30 sleepers, it was abandoned and it was decided to treat the remainder with Chloride of Zinc and oil.

6. A 2 per cent. solution of Chloride of Zinc was adopted and it was decided to try and make each sleeper absorb 9 lbs. of the solution, *i.e.*, 6 lbs. per cubic foot. After allowing the treated sleepers to dry thoroughly for several days they were immersed in Green Oil, with a view not only to protect the timber but more especially to prevent the salt from being washed out by the rain.

7. In order to ascertain the period of immersion necessary to force in 9 lbs. per M. G. sleeper a certain number of sleepers were weighed before and after immersion, the solution being first heated for about an hour to between 60° and 70° C. and then allowed to cool for 23 hours. The following were the results obtained :—

DIPTEROCARPUS ALATUS.

Experimental treatment of sleepers at Pyinmana, 15th January 1913.

Tank No. 1.

2 per cent solution of Chloride of Zinc. (Immersion period 23 hours.)

No. of sleepers.	Weight before immersion in lbs.	Weight after 8 hours' immersion in lbs.	Weight after 23 hours' immersion in lbs.	Amount of solution absorbed per sleeper in lbs.	Method of treatment.
855	77	83	84	7	Open tank, heated to 70°C. for an hour and then allowed to cool down.
841	74	78	82	8	
843	80	82	83	3	
892	72	75	81	9	
840	85	87	92	7	
Total ...	388	405	422	34	
	Average absorption per sleeper 6·8 lbs.				

DIPTEROCARPUS ALATUS.

Experimental treatment of sleepers at Pyinmana, 15th January 1913.

Tank No. 2.

2 per cent solution of Chloride of Zinc. (Immersion period $21\frac{1}{2}$ hours.)

No. of sleepers.	Weight before immersion in lbs.	Weight after immersion for $21\frac{1}{2}$ hours in lbs.	Amount of solution absorbed per sleeper in lbs.	Method of treatment.
835	75	83	8	Open tank, heated to 65°C. for one hour and then allowed to cool down.
836	70	77	7	
847	74	80	6	
861	86	90	4	
862	77	85	8	
Total ...	382	415	33	
	Average absorption per sleeper 6·6 lbs.			

DIPTEROCARPUS ALATUS.

Experimental treatment of sleepers at Pyinmana, 15th January 1913.

Tank No. 3.

2 per cent solution of Chloride of Zinc. (Immersion period 22 hours.)

No. of sleepers.	Weight before immersion in lbs.	Weight after immersion for 22 hours in lbs.	Amount of solution absorbed per sleeper in lbs.	Method of treatment.
856	62	73	11	Open tank, heated to 65°C. for 3 hours and then allowed to cool down.
893	95	97	2	
874	80	89	9	
887	85	96	11	
869	70	84	8	
846	76	82	6	
Total ...	474	521	47	
	Average absorption per sleeper 7·9 lbs.			

DIPTEROCARPUS ALATUS.

Experimental treatment of sleepers at Pyinmana.

Tank No. 4.

2 per cent solution of Chloride of Zinc. (Immersion period $20\frac{3}{4}$ hours).

No. of sleeper.	Weight before immersion in lbs.	Weight after immersion for $20\frac{3}{4}$ hours in lbs.	Amount of solution absorbed per sleeper in lbs.	Method of treatment.
839	76	91	15	Open tank, heated to 60°C. for 5 hours and then allowed to cool down.
851	71	87	16	
842	77	92	15	
848	77	89	12	
857	73	89	16	
891	67	84	17	
Total ...	441	532	91	
	Average absorption per sleeper 15·2 lbs.			

DIPTEROCARPUS ALATUS.

Tank No. 3, soaking for 24 hours in a 2 per cent. solution of Chloride of Zinc, one hour heating.

No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
1170	73	83	10
1179	72	78	6
1156	85	95	10
1199	72	81	9
1169	85	96	11
1172	82	95	13
Total ...	469	528	59
	Average absorption per sleeper 9·8 lbs.		

Tank No. 4, soaking for 24 hours in a 2 per cent. solution of Chloride of Zinc, one hour heating.

No	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
1174	84	96	12
1127	69	80	11
1140	67	89	22
1162	85	94	9
1141	80	86	6
1133	71	90	19
Total ...	456	535	79
	Average absorption per sleeper 13·1 lbs.		

DIPTEROCARPUS ALATUS.

Tank No. 1.

Soaking for 24 hours in a 2 per cent. solution of Chloride of Zinc during which the solution was heated for one hour.

No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
1214	78	81	3
1231	80	87	7
1243	84	91	7
1242	89	95	6
1232	82	90	8
Total ...	413	444	31
	Average absorption per sleeper 6·2 lbs.		

Tank No. 2.

Soaking for 24 hours in a 2 per cent. solution of Chloride of Zinc during which the solution was heated for one hour.

No.	Weight before immersion in lbs	Weight after immersion in lbs.	Difference in lbs.
1204	75	85	10
1203	82	89	7
1229	77	82	5
1248	67	77	10
1246	72	81	9
Total ...	373	414	41
	Average absorption per sleeper 8·2 lbs.		

Tank No. 3.

Soaking for 24 hours in a 2 per cent solution of Chloride of Zinc during which the solution was heated for one hour.

No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
1258	84	94	10
1257	87	92	5
1221	73	84	11
1241	71	79	8
1194	75	82	7
1224	89	93	4
Total ...	479	524	45
	Average absorption per sleeper 7·5 lbs.		

DIPTEROCARPUS ALATUS.

Tank No. 4.

Soaking for 24 hours in a 2 per cent. solution of Chloride of Zinc during which the solution was heated for one hour.

No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
1233	83	92	9
1204	78	86	8
1234	78	87	9
1213	87	97	10
1200	77	82	5
1222	84	90	6
Total ...	487	534	47
	Average absorption per sleeper 7·8 lbs.		

In all 56 sleepers were tested, the treatment being roughly 24 hours' immersion, during which for an hour the solution was heated to between 60° and 70°C. and then allowed to cool down. The result was that 56 Kanyin M. G. sleepers before immersion weighed 4,362 lbs. and after immersion 4,869 or a difference of 507 lbs. which works out 9·05 lbs. per sleeper. In the first statement it will be seen that 5 sleepers were weighed after 8 hours' immersion with the result that they took up only 3·4 lbs. per sleeper.

8. In para. 2 it was stated that timber tanks lined with zinc sheeting were tried in which the solution could not be heated. After immersion in these for 24 hours in a cold solution, 22 sleepers absorbed an average of 3·3 lbs. each nor was their weight

increased by leaving them in the solution for a further period of 24 hours. To overcome this difficulty the sleepers were heated in one of the small tanks for an hour at 80° C. then transferred quickly to the larger tanks, plunged into the cold solution and allowed to remain there 23 hours. The results were as follows :—

DIPTEROCARPUS ALATUS.

Treated for an hour at 80° C. and then transferred and allowed to remain 23 hours in a cold solution.

No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
959	72	79	7
977	68	78	10
980	81	85	4
929	79	87	8
999	75	80	5
Total ...	375	409	34
	Average absorption per sleeper 6·8 lbs.		

9. *Dipterocarpus tuberculatus*, the 'In.' M. G. sleepers were tested in a similar way to the 'Kanyin' but gave slightly lower results :—

No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
904	90	96	6
803	88	93	5
892	86	91	5
882	83	90	7
890	84	94	10
853	90	96	6
845	90	94	4
871	85	89	4
829	89	97	8
820	89	93	4
886	83	88	5
801	85	98	13
843	82	88	6
853	85	92	7
832	79	83	4
895	92	98	6
813	92	98	6
868	84	92	8
818	88	94	6
876	86	94	8
860	82	91	9
834	91	99	8
Total ...	1,903	2,048	145

The foregoing figures give an average absorption of 6·6 lbs. per 'In' M. G. sleeper. By slightly increasing the temperature an 'In' sleeper can be made to absorb about 9 lbs. in 24 hours.

10. After the sleepers had thoroughly dried they were immersed in warm Green Oil for 5 minutes, the average of 5 sleepers weighed before and after immersion worked out as follows :—

DIPTEROCARPUS ALATUS M. G.

Sleepers immersed for 5 minutes in Green Oil heated to 50° C.

No. of sleeper.	Weight before immersion in lbs.	Weight after immersion in lbs.	Difference in lbs.
900	75·5	77	1·5
1,123	73·5	74·5	1
897	74	75	1
824	77	78	1
879	89	90	1
Total ...	389	394·5	5·5

11. Until all expenditure has been accounted for the cost of treatment cannot be calculated ; it roughly works to 1 anna 10 pies per sleeper for the Chloride of Zinc, 9 pies for the oil, 1 anna for handling, total 3 annas 7 pies per sleeper for treatment.

R. S. PEARSON,
I. F. S.

THE NEED OF FIRE-PROTECTION IN THE TROPICS.

For various reasons I have delayed replying to criticisms on my note on the above subject in the issue of the *Indian Forester* for May 1912. I am now glad of this delay as it enables me to deal with more recent ones at the same time and to quote further supporting evidence.

In the first place, I owe an apology to Mr. E. A. Smythies. I must admit that the impression left on me by his article was that, on the whole, he was opposed to fire-protection in Chir forests. I am delighted to find from his note in the August issue that he

does not hold this opinion. Nevertheless, I think that I was justified in using part of his article in support of the "too much protection school" under *certain conditions. A fuller* quotation would have done him more justice but space was wanting.

Next I come to Mr. Pearson in the issue for September. I am at a loss to understand his objections since all he writes is in entire agreement *with the qualifying 2nd and 3rd conclusions* of my note, which read :

"II. In certain forests, however, fire-protection unaided by other operations hinders the natural reproduction of the most valuable species, *especially in the case of teak forests.*"

"III. Improvement fellings and cleanings on a sufficient scale suffice to establish natural regeneration in the forests referred to."

Whether the "other operations" are always feasible or not is another matter altogether, as *I myself admitted when I wrote :* "Though probably it will not be possible for many years to come to effect such improvement fellings over the whole of the vast areas of teak forests........" (*Indian Forester*, May 1912, page 219). In any case, *what is the beneficial action of fire in a forest where* Mr. Pearson claims it does not do harm? Is it not in the nature of "an improvement felling or a cleaning on a sufficient scale"? Also is its action entirely beneficial? If not then an agency which *will reproduce its beneficial but not its harmful effects will be* preferable. That is all I claim, *i.e.*, that fire is harmful in all forests, but protection under certain conditions *may be* more harmful still if unassisted by other operations.

Further, I *have recently read through the Working-plan for* the Ankola-Kumta Coast Forests (Bombay Presidency) by Mr. P. E. Aitchison. I gather that the forests here dealt with are—in part at least—very similar to those referred to by Mr. Pearson and yet the Working-plans Officer enters "Fire" at the head of the causes of injury they are exposed to and goes on to state : "At one time fires were very frequent; but the evil is being gradually but surely suppressed and there is little doubt that the regrowth and general conditions of these forests has consequently improved considerably during the last 10 to 15 years". Para. 12 of the

report shows that improvement fellings have accompanied fire-protection.

I must turn to Mr. Walker (September 1912, page 436 *et seq.*) and I admit that I hardly know how to treat his arguments after his admissions of "foolish suggestions" and puerility. Mr. Walker accuses me of a poor choice in selecting points in his previous papers and proceeds to give those he himself would have selected. Firstly I must disclaim any selection; I tried to deal with all his points, including the puerile ones (*peccavi*) and I have dealt with all those he himself selects. However, I will review a few of his later remarks.

Page 440.—Mr. Walker shirks the inquiry into why we do not find pure or almost pure teak though his school has stated that "fire may be considered........as an agent favouring teak at the expense of all (or almost all) other species." And yet he himself (page 439) lays stress on the "struggle for existence." He goes so far as to say that we know practically nothing about the complex relations between species and that, in any case, little would be gained by even the solution of the problem!

Page 443.—I will at once admit that many saplings are killed by suppression; but still more are killed by fire (my assertion is restricted to the forests I know, but others have said the same of Burma forests) and many more survive that are injured. These injuries are progressive if fires continue. Also suppressed trees suffer more from fire than healthy ones—yet unsuppressed ones are also injured as I have myself observed. Last hot weather I camped in an unprotected teak forest which had been burnt over. I picked up many teak seeds that had been burnt by this "leaf fire" and on cutting them open could not discover an unshrivelled kernel. I noticed one teak sapling in particular. It stood in the open space in which my camp was pitched. It was not suppressed in any way; it was about 10 feet high and nearly 1½ inches in diameter. A scar 2 feet in length disfigured the stem and its depth showed that it was an injury of more than one year's standing.

Page 445.—Mr. Walker here states that it follows that if the forests were cleared off the sal area quoted by Mr. Clutterbuck

where natural reproduction failed for 26 years, no field crop would have grown without the application of manure. I am disposed to agree with him in case the cultivator ignored the plough as Mr. Walker has done. A little further on Mr. Walker shows that he thinks the food-material was deficient, apparently he is unaware of the importance of the physiological condition of the soil.

Page 447.—Mr. Walker rightly points out an error of mine in making him responsible for the opinion "either that nitrogen is not an essential plant-food, or that it remains in the ash." What I should have stated is that that is the logical conclusion of what Mr. Walker had written, I was unjustified in attributing to him the only opinions arising from his assertions. (Again *peccavi.*)

However, as Mr. Walker now admits that nitrogen *is* an essential plant-food, I will leave that point alone. As regards his renewed statements that the nitrogen in the soil is not affected by burning and is derived from other sources than forest debris, they are so involved and the several passages so contradictory, that I must refrain from unravelling and refuting them piecemeal. I would only point out that in several places I find Mr. Walker using the words: "so far as I could gather," "so far as I remember," "so far as I can ascertain," etc. I have been at pains to quote authorities and I cannot accept a mere *ipse dixit* in refutation. For Mr. Walker's benefit I will make one more quotation from a discourse delivered by Mr. A. D. Hall, F.R.S., at the Royal Institution (see *Tropical Agriculturist* for October 1912, page 318, "The fertility of the soil"). "......on land running wild the vegetation is never removed but allowed to die naturally. Hence not only is the nitrogen taken out by the crop returned to the soil, but also a large stock of carbonaceous matter, and this carbonaceous matter furnishes a bacterium present in the soil, *Azotorbacter chroococcum*, which will enable it to fix atmospheric nitrogen."

Mr. Hall then gives details regarding a plot at Rothamsted which has been allowed to run wild for 23 years. During that period it accumulated 2,200 lbs. of nitrogen per acre, of which only 90 lbs. was added by rain. Had the field been burnt over

every year all but the 90 lbs. would have been lost and in addition some of the original stock (5,910 lbs. per acre), *i.e.*, that portion contained in the surface few inches. Mr. Hall concludes: "This plot gives us a clue to the source of the vast accumulations of nitrogen in the old prairie soils."

I am quite sure that Mr. Walker is very earnest and very sincere in his opinions on the subject, but I am not convinced that his observations are invariably accurate or his inferences always justified. I admit at once that I am ignorant of Burma conditions and it is for that reason that I quoted extensively from writers who have had experience there. I claimed no finality for my note and wish no one to accept my unsupported testimony, but I certainly want more accord among Burma Officers before I can accept what amounts to a revolution, *i.e.*, that it is better to burn forests even though reasonable regeneration can be secured by other means, while protecting them against the evils of fire.

I cannot refrain from supporting myself further with some quotations from the Administration Report for Eastern Bengal and Assam for 1910-11.

"As a result of fire-protection grass lands are filling up with sal."

"Five annual clearings will ordinarily render an existing sal seedling safe from suppression by undergrowth." (The report shows that 5,951 acres were so assisted in Jalpaiguri during the year.)

In the issue of the *Indian Forester* for January 1913, there are two more articles that I must notice. One is by E. A. S. in support of Mr. Walker and I will deal with it first.

Here again we have a wilful ignoring of the destructive effect of fire on nitrogen and nitrifying bacteria. The author mentions "4 most important classes of creative micro-organisms in the soil;" of these the fourth at least must be inoperative with annual fires, since the plants in which the nitrogen is accumulated are themselves burnt up and the nitrogen set free. As for the rest of the article, besides the quotations printed in my first contribution in the issue for May 1912, I may here extract some passages from

a communication from Mr. W. H. Harrison, Agricultural Chemist, Madras, which I asked for specially for this rejoinder.

"... . ...the fire would dissipate all the nitrogen contained in the part of the soil actually burnt and also to a less extent in the immediate zone below—say the top few inches........"

"........in these top few inches the bacterial flora will be very greatly reduced and some time must elapse before conditions are normal again........the destruction annually of the surface débris prevents it being worked into the soil, thus greatly reducing the formation of humus and consequently tending to alter the soil texture."

I should like Mr. Walker and those who agree with him to trace out these facts to their ultimate conclusions. In the second sentence quoted above Mr. Harrison is writing of a single fire and yet he states that "some time must elapse before conditions are normal again." Does this not support Mr Clutterbuck's contention that after a long period of annual firing the soil requires a considerable rest in order to become fit to become a seed-bed? The reason for this is not so much loss of plant-nutriment but physiological deterioration.

Finally, I come to Mr. Barry's contribution on page 26 of the January number of the *Indian Forester* and I must confess that much of it I do not understand. As far as I can grasp its meaning, however, it seems to me that Mr. Barry first states that he disagrees with me as regards the effect of fires in moist forests and then proceeds to prove more or less that I am right. He refers to Mr. Pearson's article but we have already a counterblast in Mr. *Aitchison's Working-plan.*

Mr. Barry compares coupes 7 and 8 with coupes 5 and 6 of a certain working circle, but gives far too little information for a true comparison. Still, one gathers that in 7 and 8, where the growth is poor, fires have been prevalent until very recently, whereas in 5 and 6, *which have been protected, the growth is far better.* Then we come to the fact of want of reproduction of the better species in 5 and 6. But apparently these two coupes have not yet been touched and no improvement fellings or other operations

have assisted fire-protection, and that is the crux of the question It seems to me that Mr. Barry, like some others, have not read my paper properly and I must protest against criticism based on a partial or careless perusal.

Mr. Barry quotes from his diary a paragraph regarding the Mavina Kodlu Reserve: "Every decent timber tree has been removed........having (leaving?) a few poles and misshapen old trees of saleable species and an abundance of creepers and evergreen trash—the two latter thriving owing to fire-protection and the *absence of improvement fellings*." The only effect of quoting a mismanaged forest is to strengthen my point by the last four words.

I cannot see that anything that has been written since negatives my five conclusions of May 1912 and I recapitulate them here, somewhat abbreviated, for convenience:

I. In all forests fires are harmful. (This obviously means in certain directions and not that fires have no beneficial effects at all.)

II. In certain forests, however, fire-protection unaided by other operations hinders natural reproduction of the most valuable species.

III. Improvement fellings and cleanings on a sufficient scale suffice to establish natural regeneration. (This does not assert that a sufficient scale is always and everywhere attainable, in fact I expressly admitted that it is not.)

IV. Fire-protection is essential in—

(*a*) Forests required for water-supply or protection against erosion.

(*b*) Forests where natural regeneration is secured or artificial regeneration is preferable.

V. Fire-protection to be really effective must be continuous. (This, of course, is qualified by conclusion II *supra*.)

As it appears to me the question is this: The only evil effect than has or can be attributed to fire-protection is the hindering of natural reproduction. On the other hand fire must achieve a

certain amount of harm. Is it not then the essence of sylvicultural science to devise some means of securing the one while avoiding the other?

I think that all Forest Officers would gladly welcome freedom from the reponsibility and labour of fire-protection if it could really be proved that it does harm and that satisfactory results can be obtained in spite of regularly recurring fires. Personally, I will gratefully acknowledge my error when I am convinced. Meanwhile, to the best of my judgment, a very grave mistake would be committed were efforts relaxed on the strength of the evidence adduced so far.

COIMBATORE: *22nd March* 1913.

C. E. C. FISCHER,
Deputy Conservator of Forests.

A MAN-EATER IN THE HIMALAYAS.

It is not often that tigers wander up any distance into the Himalayas, it is still less frequent for them to haunt the environs of such a populous place as Naini Tal, while the presence of a man-eating tiger, who started his evil operations in September 1911, and haunted the forests surrounding Naini until the day of his death eight months later, appears to be unique. At least Naini Tal does not appear to have had such a visitation before, although Chakrata, many years ago, had to suffer a whole family of man-eating tigers, the last of which was shot by Mr. B. B. Osmaston, I.F.S.

To gain some idea of the country over which the Naini Tal man-eater roamed, I may state that his beat was covered roughly by a 10 mile radius, with Naini Tal as the centre, that the country generally is covered with thick forests, varying from the Sal forests of the plains (2,000′) to the high level evergreen oaks (8,000′), that the slopes are everywhere steep, and frequently precipitous. In addition to the Naini Tal and Ranikhet cart-roads, the country is intersected by numerous and much frequented bridle-paths, and honeycombed with villages. To meet the requirements of the station, the surrounding forests are very intensively

worked for fuel, grass, timber, charcoal, lime, etc., and countless coolies are always scattered about. Altogether the tiger showed discrimination in choosing such a favourable place for his nefarious operations, the only drawback from his point of view being that latterly some Sahib or other usually arrived on his kill before he had had time to finish it. His first authentic kill was in September 1911, when he seized a villager 10 miles N.-E. of Naini Tal. He then transferred his attentions to the S.-W. of his beat for two months, killing four or five persons in that time. After a brief excursion to the north of Naini Tal, in which he killed a sawyer in the forest, and was missed by a young Subaltern (who saw him stalking *gural* on some precipitous ground near a Forest bungalow called Kilburry, and had three shots at him), he returned to the Fatehpur patti, and in the beginning of January became outrageous. He killed nine persons in eleven days between 2nd—13th January. It was at this time that he was seen by Major Dunn, I.M.S., again stalking *gural*, unfortunately he could not get a shot at him. After this disastrous week Government put a reward of Rs. 500 on his head, but he continued unmolested for some time, wandering about in the jungly parts on the outskirts of the Bhábar. On the 25th February he suddenly transferred his operations to his original area to the N.-E. of Naini Tal. I happened to be with two friends at a P. W. D. bungalow on the Ranikhet cart-road called Ratighat, and we were amusing ourselves in the afternoon having long pot shots at some *gural* on an opposite khud, when an excited villager turned up and explained that a woman had just been seized from his village about two miles away. We hastily collected our heavy rifles, some coats, eatables, and a lantern, and went off to have a look. The two miles developed into five and it was almost dark when we arrived at the spot, a deep precipitous ravine, 200 yards wide, 200 feet deep, filled with fearful scrub, bushes, and forest, but bounded on both sides with terraced wheat fields. It would have been futile to hunt for the tiger and his prey that night in such a place, so we returned and organised a beat for the next day. As we failed to get him, the details of that beat need not be given. It will suffice to say that he apparently preferred

to break through the line of coolies, some of whom said they caught a glimpse of him, which is more than we did. We recovered the half-eaten body, and gave it to the poor husband, whose grief was pitiful.

On the day following our unsuccessful effort he went to a village about 7 miles away (and incidentally up 3,500′), near the Kilburry Forest bungalow and killed another woman. It was this kill for which he had to climb a tree, as already reported in the *Indian Forester* (p. 291 of June 1912). Mr. Sykes, who went out from Naini to sit up for him, on arrival found the body gone, but followed up the marks, and found it again about ¾ mile away in heavy jungle. He sat up over the remains for that night, all the next day, and the following night, with the two natives who had gone with him shivering with cold and shaking with fear in adjoining trees. The tiger prowled and growled round the spot, without showing himself, but in the middle of the second night, when the moon had set, and everything was black as pitch, he dashed in and rushed off with the body, without being seen.

He hung about the neighbourhood for another 10 days without killing, and when we arrived at Kilburry on the 11th March, we found his fresh *pugs* round the bungalow. These were evidently his departing footsteps, however, as he disappeared for a fortnight (and although I had buffalo calves tied up in all directions, and wandered about the forests all day trying to find some sign of him, I failed to do so). For a clear month he did not kill human beings.

At the very end of March he turned up again, and killed a girl, and a native villager managed to put a 12-bore solid lead bullet into him out of an antique old gun, without however seriously injuring him. His next, and as it transpired, his last kill was on the 18th April, under somewhat peculiar circumstances.

I happened to be at Almora, when I had a wire to meet my Conservator, Mr. B. B. Osmaston, at Bhawali, 27 miles from Almora and seven from Naini Tal. By a flying march I arrived at Bhawali about 2 P.M. of the 19th, and found that the tiger had killed the day before about five miles away, and Mr. Osmaston

was just preparing to set off to the place. As I had brought no gun or rifle, Mr. Osmaston fitted me out with his gun and three Lethal bullets which he happened to have with him, and away he went. On the way he gave me a thrilling description of his first man-eater, and how it had sprung out and collared the man who had gone out with him, and how he had shot it while they were rolling down the hill together, and how the man was badly mauled, but ultimately recovered, and so on. I hoped history was not about to repeat itself, with myself in the rôle of the roller, and my nerves, which were quite sufficiently excited already, were not soothed to rest by the anticipation of a similar experience. However, when we got to the spot, we found at least fifty villagers, a *patwári*, various *Forest Guards*, and so on, scattered about in the jungle where the body of the victim was lying, so it was clear that the tiger was not laying up near his kill. This we found under some thick bushes in the bottom of a nala, with almost precipitous sides, dark and shady, under a number of evergreen oaks, and scarcely 100 yards from the Ranikhet cart-road. The body of the man was a horrid sight. The tiger had evidently killed him with his paws and claws, and not, as is customary with tigers, with his mouth. There were numerous claw marks on the shoulders and back, showing up livid on the brown skin, the face had been completely flattened by a blow, and the head was twisted round on the body in an impossible manner. One leg was gone, and half the other, together with both the hands. We did not linger over this horror, but had the bushes cleared away, and sent a man for a *machan*.

Mr. Osmaston then determined to leave me the *machan* and the kill, as he said he had no desire for an all-night sitting, and he would go and sit up for a bit in an adjoining nala, where the tiger was probably lying up, to try and get a daylight shot at him. This sporting and unselfish action was, I am convinced, to give me, the novice, the chance of the tiger. I feel filled with gratitude whenever I think of it.

The *machan* arrived at last, and I proceeded to have it fixed up in a beast of a tree, sticking out of the cliff side, without

a branch for twenty feet, but the only tree suitable for the *machan*.

The two coolies took at least an hour to fix up the *machan*, while I sat at the foot of the tree and smoked. They were still hard at work when an excited villager came flying down to say he had seen the tiger about a quarter of a mile away, that he was coming down slowly in our direction. I wriggled up that beast of a tree in a phenomenally short time, and made myself comfortable in the *machan*. The chaprasi then lit a lantern, and placed it about five feet away from the body (which was ten yards or so away, and twenty feet below me), and put my topee leaning against the lantern to cut off all rays in my direction, and he and the coolies departed. It was then seven o'clock, and beginning to get dark, but there was still plenty of daylight to see by.

Not five minutes after the man had gone, I heard a regular pitpatter on the dry leaves coming up the nala, and immediately experienced the feeling of suffocation, the pounding heart, the gulping mouth, and all the other sensations which go to make up the charm of *machan* shooting. However, this was a false alarm, caused by two pheasants, which went scratching up the nala, and I heard them presently settling themselves for the night in a neighbouring tree.

As the daylight faded, the body, in the middle of a ring of light thrown by the lantern, stood out clearer and clearer; and the lantern flickering in the wind gave it a curious appearance of movement. It was curious sitting up in the stillness over that shimmering and ghastly sight, and hearing the jingle of a tonga, and the creak of a bullock-cart passing 100 yards away.

After about half an hour I again suffered all the sensations of intense excitement. There could be no mistake this time, it was undoubtedly a heavy animal coming down the precipitous slope at my back, and making considerable noise, about ten feet away from me, and on the same level, but although I twisted my neck until it nearly broke, it was too dark to see anything. However, the tiger did not spot me and went on, sliding and slipping into the nala, until he was vertically below my *machan*. Every-

thing was as black as the pit, except in the circle of light thrown by the lantern. When the tiger saw the light, he sat down to consider it, spitting and grumbling to himself. Then I heard him cautiously advancing, and after perhaps five minutes, I saw his head, half facing me, thrust into the halo of light, glaring at the lantern. Then he advanced fully into the light, and stood over the body of his victim, still half facing me.

Seeing him so to speak at my mercy, I suddenly felt as cool as the proverbial cucumber, and raised and lowered my gun once or twice to see if I could see where I was aiming. Then aiming at the junction of his neck and shoulder, I fired. The flash of the gun blinded me for a moment, and when I could see again, it was evident he was not in the light, there was no roaring or growling, there was, on the other hand, no sound of retreating footsteps, only a curious swishing noise as if the tiger was waving his tail about in long grass, which went on for a full minute, and then ceased. *Presently I heard a faint bubbling sound, which, to* my novice ears, did not reveal the significance of what had happened. Completely nonplussed, I wrapped myself up in my rug and prepared to go to sleep, when I heard Osmaston's voice shouting to know what had happened. I explained my bewilderment at the top of my voice, laying special stress on the fact that I was sure the tiger had not gone away. However, with a courage which I do not profess to possess, Osmaston shouted to say he was coming down to me to investigate, and with the help of a lantern and the inevitable cooly, proceeded to crawl down through the pitchy darkness and the precipitous jungle to my tree.

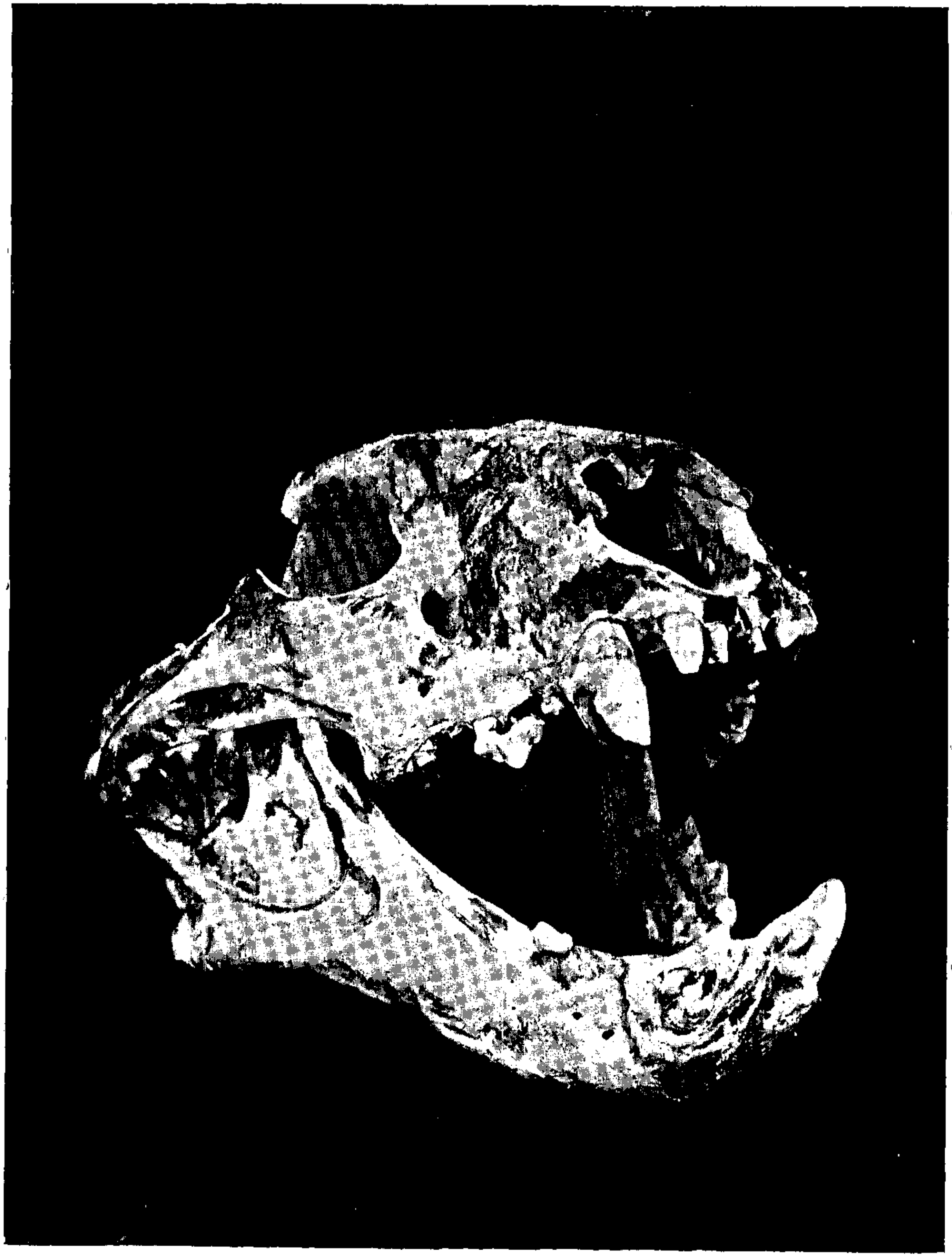
Having arrived in my *machan*, he switched on an electric torch, which lit up the whole area, but no sign of a tiger was to be seen. Pretty well convinced that I must have missed him, and that he had gone away without a sound, we determined to go back to Bhawali and come again in the morning to investigate more carefully. Lingering gleams of hope persisted however to break the monotony of my disappointment, and when on the way back I mentioned the faint bubbling noise, the remark that that sounded much more hopeful, and must have been blood from his

lungs, cheered me enormously, But why then had he not roared? and why had we not seen him?

In this state of perplexity we remained until next morning, when, as we were again going down to the place, an excited villager met us with the joyful news that the tiger was dead. Arriving at the spot, we found a crowd of villagers singing dirges round the body of the man, and eight feet away, another and larger crowd chanting triumph round the body of the tiger. When they saw us, they broke off, to commence bowing their heads to our feet and grabbing our knees, and hailing us as deliverers. Cutting short this embarrassing ceremony, we hastened to examine the tiger. The bullet, we found, had smashed the spine in his neck, killing him instantaneously. He had tumbled out of the light, and slowly slipped down hill behind a large tuft of grass, which prevented us from seeing him on the previous night. In this simple way our perplexities were solved.

The tiger himself was an old male, 8′ 9″ between pegs when we measured him. He seemed in quite good condition, and his coat was not in the least mangy. His mouth and jaws (which are excellently shown in the accompanying plate), were most extraordinary, and clearly showed why he had become a man-eater, and why he killed his victims with his claws. His right jaw must at some time have been raked by a shot, smashing both canines, and knocking out all his molars.

His left canines were also decayed and useless, leaving only his left molar teeth fit for use. We also found a fairly recent wound in his chest, and the 12-bore solid lead bullet, mentioned above, under his skin below the shoulder. Osmaston, after much grubbing about, brought to light a dozen or so human fingers and toe nails from the beast's stomach. This however was subsequent to the triumphal procession which brought him up along the cart-road to Bhawali, and which, like a snow ball, swelled and grew as it went along, until half the district seemed to debauch into the bungalow compound, and clamour for their share of largesse. Thus ended the career of the man-eater of Naini Tal; during the seven months that he terrorised the district, he



SKULL OF A MAN—EATING TIGER SHOT IN THE NAINI TAL DISTRICT.

accounted for at least 25 victims; he caused several villages to be deserted, and for varying periods completely stopped all forest work, and all traffic on the bridle roads.

E. A. SMYTHIES,

Assistant Conservator of Forests,
Naini Tal Division.

15th January 1913.

EXTRACTS.

The followiug useful recipes which recently appeared in an Industrial Magazine have been sent us, for insertion in the pages of the *Indian Forester* so that they may be widely known to all interested in timber, by Mr. R. S. Nagarkatti of the Forest Department, Belgaum :—

TO PRESERVE TIMBER FROM THE RAVAGES OF WHITE-ANTS.

Dissolve 1 lb. of chloride of zinc in 9 gallons of water in a wooden tank. The timbers are required to be immersed for about two days for each inch in thickness in the above tank and are afterwards to be taken out and left to dry in shade for about from 14 to 90 days. To facilitate the drying operations the solution may be forced into the pores of the timber with a pressure of 150 lbs. to the square inch. This process has the advantage that it renders the material, to which it is applied, incombustible. Large quantities of timber may be thus preserved, only the solution should also be made in large quantities.

TO RENOVATE MAHOGANY.

Dissolve 4 ounces of best white wax in 8 ounces of turpentine and 6 ounces of water in a glue kettle over the fire, and while hot add an ounce of ammonia. Stir well together whilst cooling. Remove all dust from the articles ; then apply with old pieces of clean flannel and polish. Before renovating, if there are dents in the furniture, cover the places with a damp rag, and iron with red-hot iron and then polish with the following solution :—Equal parts of linseed oil, vinegar and water. Put them in a bottle and shake well together and apply with a piece of flannel, and polish with soft cloth.

FIRE-PROOFING WOOD.

An excellent method of rendering timber impervious to fire is to cover its surface with a solution of silicate of soda. When wood treated in this way is exposed to a fierce flame, the heat draws the salt contained in the solution to the exterior of the timber on which it forms a glazed coating, after having been melted by the action of the fire. The solution should be generally adopted as a wash for woodwork in houses, as it effectually retards the action of the flame which the resinous nature of the deal commonly used in building is too liable to promote.

SCRUTINY OF FOREST CONCESSIONS BY THE GOVERNMENT OF INDIA.

The following is the text of the circular recently issued by the Government of India to Local Governments and Administrations :—

"As a consequence of the recent industrial expansion in this country the commercial demand for forest products has of late years considerably enlarged and Local Governments are now frequently approached by the commercial public with requests for the grant of concessions in connection with the development of new industries such as those relating to the manufacture of paper-pulp, matches, tannin extracts, acetones, etc.

2. The Government of India are anxious to give every encouragement to new enterprises of this character and Local Governments have hitherto dealt with them in a liberal spirit, but as the class of transactions under consideration differs considerably from those connected with the ordinary trade in timber and other well established forest industries, it must frequently be the case that neither Local Governments nor their Forest Officers have at their disposal the information and experience necessary to enable them to deal satisfactorily with applications for concessions in connection with these newer forms of enterprise. Concessions may consequently be granted and terms conceded to the same class of industry in different provinces which may vary so markedly

as to cause serious inconvenience. The Government of India on the other hand being in correspondence with the different provinces and having at their disposal the advice of the authorities of the Forest Research Institute at Dehra Dun (where the most careful attention has of late years been bestowed on the development of new forms of forest industries) are, as a rule, in possession of better information than Local Governments for dealing with applications for this class of concession, and they therefore consider it desirable that for the present at any rate contracts of this character should be submitted for their scrutiny before being formally ratified by the Local Governments.

3. The Government of India are unable to define with precision the class of concessions which they desire to be referred to them, but it will be recognised that while they have no desire to modify in any way the existing arrangements for the grant of ordinary forest contracts in respect of the extraction of timber and the maintenance of existing and well established industries, or to necessitate the submission of contracts of any kind which are of a comparatively trivial and unimportant character, they should be consulted before any contracts or amendments of contracts are entered into which extend over a period of years or over considerable areas and are connected with proposed new industries or newly established industries which promise to be of commercial importance.

4. The submission of such contracts to the Government of India is not intended to preclude Local Governments or their officers from obtaining the advice and assistance of the Forest Research Institute during the progress of negotiations previous to the final preparation of the agreement between Government and the concessionaires and the Government of India trust that full use may be made by Local Governments of the information and experience which has been collected, often at considerable expense, by the expert officers attached to the Institute."

THE BEST TIME FOR SAWING WOOD.

Questions are asked from time to time as to what is the best time for converting wood—immediately after being felled or allowing the logs to lie for a considerable period. Now, anyone who has had experience of the characteristics and conversion of wood will decisively advise that the best time for sawing almost all kinds of wood is as soon as possible after being felled. All wood—pine and hardwood alike—tends to deteriorate in quality and colour when left for months or years in the log. If the bark is allowed to remain on the stick deterioration and discoloration will take place more rapidly than if the log was stripped of its bark. Of course, floating ponds preserve the quality and colour of many kinds of wood, but one objection to keeping wood floating in ponds is that it adds to the wetness of timber. Wood which is sawn into planks and boards shortly after being felled, and primed in the drying shed or even in the open air, improves in quality, and many kinds of wood immediately after being converted would retain their quality and colour for hundreds of years in the drying shed, whereas if the logs were allowed to remain in the open air the natural quality and colour of the timber would deteriorate in a few years. In view of these facts it is advisable to saw timber as shortly after being felled as possible.—[*The Timber Trades Journal.*]

A NEW DRUG.

An American journal states that Dr. B. Z. Bayon, who penetrated into the fastnesses of the Caquet, a region adjoining the now infamous Putumayo district of rubber atrocities fame, has just returned with specimens of a marvellous drug, extracted from a climbing plant by the natives of that place. He found that the drug, which is the active principle of this plant, which is called *yage* by the natives, is anti-anæmic, and produced very beneficial effects, in lessening and even curing the much-discussed disease "beri-beri." But the doctor discovered that it had other and different qualities, and exercised an influence over the brain. It

s said that a small quantity will throw the person who takes it into a cataleptic state or trance, in which they see hidden things, hear mysterious music, and are able to describe what is going on in the world. One of the companions of the learned doctor, the commandant of the district, persuaded Dr. Bayon to give him a few drops one night, and in the morning he described his experiences, which had conveyed to him the knowledge of his father's death and of his sister's severe illness. The nearest outpost of civilisation was fifteen days distant, but a month later the news was found to be true. The new drug is to be most carefully and scientifically examined. Dr. Bayon has named this active principle "telepatina." Should *yage* be found to possess all the virtues claimed for it, the world may drift back into a belief in "Dreamland, where all our dreams come true."—[*Indian Planter's Gazette.*]

MATCH FACTORIES.

The Match Factory started in Rangoon by the Hon. Mr. Lim Chin Tsong and another one opened at Mandalay by Mr. Darwood are on the way to certain success. There are many woods found in Burma which are quite suitable for match manufacture. The wood known in Burmese as 'tanksha' (*Vitex glabrata*), which is very common in Burma, is an excellent wood, so is the *Stephegyne diversifolia* (binga in Burmese). The *Diosypros ehretioides* known in Burmese as 'aukchinsa' is good for matches and inside boxes. Matches of very good quality are at present imported from abroad and sold throughout the Indian Empire at extremely low rates. If the match industry in Burma and India is to reach the importance which it should do, it is necessary that the qualities of matches manufactured should be of a high order; cheapness of production ought not to be a bar, considering the comparatively low rate of labour and the abundance and cheapness of suitable wood in many parts of the country. The question of sites for match factories is a most important one. Match factory sites should usually be on or near a railway, navigable river or other

main line of communication, and should be situated either near the forest or else on a floating stream, for it must be remembered that water transport is the cheapest of all methods of conveying timber, while for purposes of match manufacture the wood itself remains fresher and in better condition if kept in water than if kept for any length of time in a dry state.—[*Capital.*]

ARTIFICIAL SPONGES OF PAPER.

Paper-pulp is treated with zinc chloride to produce a viscous mass; sodium chloride is then added, the mass thoroughly rinsed with alcohol, and finally submitted to the action of a press whose platform bristles with a number of fine metallic points or projections. These penetrate the mass, forming tubes like those in an ordinary marine sponge. The block thus obtained is of spongy consistence, says the *Scientific American*, and is both insoluble and unalterable in water. It is smooth and pleasant to the touch, and not liable to putrefaction.—[*The Pharmaceutical Journal and Pharmacist.*]

ARTIFICIAL RUBBER FROM TURPENTINE.

It is stated that a Norwegian engineer has succeeded in finding a method to produce artificial rubber of excellent quality from turpentine. The product has been examined by specialists in rubber, who declare that it has both the appearance and the quality of natural rubber. The principal material in the manufacture is turpentine, but kerosene may be used. The product is calculated to cost not more than $\frac{1}{3}$ as much as natural rubber. A Swedish stock company has recently bought the invention and taken out a patent for all countries.—[*The Indian Trade Journal.*]

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TEAK AND BAMBOOS IN BURMA.

In the *Indian Forester* for December is a criticism by Mr. Walker of my article under the above title which appeared in August last. There is certainly no need for Mr. Walker to apologise for anything he has said in his paper. The magazine loses its value very materially if it is not to be the vehicle for the free exchange of ideas. This point seems to me to specially need to be emphasised in Indian Forestry at present. When we have reached the stage that one of the principal articles of the belief we brought from home stands condemned as not having universal application, it seems to me ridiculous to shut our eyes to the fact and not to take the rest of the service into our confidence.

The Honorary Editor is under no obligation to accept every article that is sent to him, and may safely be left to draw the line as to what it may or may not be desirable to publish.

Labels are useful in their place, but they are of doubtful value when they do not mean anything really definite. The labels freely bestowed on other people in this controversy about fire-protection in Burma are certainly misleading and tend to accentuate differences rather than to remove them. There is not one of us

who now believes that protection is good under all circumstances, and that fires are bad under all circumstances. There is not one of us who believes that protection is all bad and fires are all good. Very well then ; if these statements are correct there must be some common ground on which we can all meet. Granted ; then it cannot but do good for us to analyse our own and other people's opinions with a view to the bringing together of all the points we have in common.

A good deal of the confusion of thought that at present exists is due to a want of appreciation of the essential difference there is between facts in Nature and our observations of and deductions from them. Too often the one is taken for the other. What we call facts are merely the inferences we draw from what we see. One man walks through a forest and sees more than another and draws different conclusions. Both are right, as far as they go, but they must be prepared to admit this before they can ever hope to come to an agreement. Seeing how complex a thing a bit of forest is and how easy it is to overlook important factors, it does not seem superfluous to invite attention to these somewhat commonplace remarks.

Teak grows under such varied conditions in the different parts of Burma, that the truth is never likely to be elucidated until the subject is studied in a less haphazard way than at present. One man writes about one forest and another about another. Neither writer is certain that the conditions are similar in both cases. An infinitely better plan is to compare notes about *the same locality*. If every Forest Officer in the province were to make a point of studying one small area a year thoroughly and were to try and get another officer to look at the same bit of forest we would make much more rapid progress than at present.

By the term "the same locality" I must not be supposed to mean necessarily a whole division or block or even a whole compartment. Until we are agreed as to a correct and complete classification of the types of growth in which teak grows, it only tends to confusion to include large areas in which the local conditions are not uniform.

The remark in para. 12 of my article ought not to be lost sight of when comparing and classifying the facts recorded and inferences drawn by different observers. As a rule we only take in what we set out to look for. It is but natural to suppose that what we do not see does not exist. It took me a year to realise that there was such a thing as *tin wathon* in Pyinmana, although it was staring me in the face more or less everywhere.

My comments on Mr. Walker's article will probably owe much of their value to the fact that I am at present touring in Arakan with him. We have burnt out many a pipe of an evening discussing the subject, and, I think, not without mutual benefit. If this dicussion has done nothing else it has given us some insight into the way we each of us look at things, and this is really a long step towards coming to an agreement as to the differences between us.

2. The first part of Mr. Walker's paper is based on a misunderstanding, the removal of which shows that we are really by no means at variance in our ideas about the effect of bamboos on the growth of teak. Mr. Walker assumed that I meant that teak reproduction (or germination) was principally confined to the time of flowering of bamboos. What I said was that *regeneration* took place then. I should have said that young growth already on the ground as well as freshly germinated seedlings then had a chance of establishing themselves and of developing.

There is a good deal of looseness about our forest use of the terms *germination*, *reproduction* and *regeneration*. The first two are generally more or less synonymous and are applied to individual seedlings. Regeneration, on the other hand, usually refers to a whole crop, and means much more than mere germination, for it is spoken of as being incomplete until the young crop has established itself and is in a position to go ahead. Regeneration may therefore represent a period of time which may cover anything from a single year to, possibly, half a century or more. It is the unknown quantity (generally taken at 10 years in Burma) added to the rings on a stump for estimating the theoretically correct age of teak trees.

I do not wish it for a moment to be supposed that I think that germination of teak is limited to bamboo flowering epochs. Teak seeds freely every year, and I believe that germination takes place in abundance every year, and that it does so to an infinitely greater extent than we can ever trace. It is only one seedling in a thousand that lives long enough for us to find it, even within a year.

Once started the seedling wants light and possibly other things. Without them its growth is arrested. How many years teak can stand being kept back no one knows. I have seen for myself plenty of examples that convince me that Mr. Walker is not exaggerating in stating that seedlings can persist for as much as 30 or 40 years. My point is that if they are given a chance to go ahead, when the trees come to be felled, the stumps will show the same number of rings as seedlings which germinate this year and never lose their leading shoots.

With this explanation Mr. Walker tells me that he has no quarrel. He believes as much as I do that the wholesale removal of cover that takes place when bamboos flower gregariously does *indicate times when teak has a special chance of establishing itself* and of going ahead. We only part company at present when it comes to a question of regeneration at other times. Mr. Walker believes that an appreciable amount can be got by improvement fellings *in bamboo areas*. I doubt the possibility of doing this over all the bamboo forests, and even if it could be done, I think the same result could be attained at less cost by concentrating our energies on areas in which bamboos have recently flowered or are about to do so.

3. Mr. Walker takes exception to my want of faith in improvement fellings. If the remarks I made in para. 25 be referred to it will be seen that I cast no doubt on the value of such operations for helping on saplings and poles. All of us are agreed on this point. Many of us are also of opinion that it will be impossible to maintain the present rate of girdling *without a check* for a longer or shorter period. If the stock of II class trees is deficient in proportion to that of I class trees, it will not help us

in removing this falling off by devoting all our attention to regeneration. A reduction of girdling would meet the difficulty. This reduction, however, need not be so great and might possibly be avoided altogether if we laid ourselves out to help on all II class trees or, using Mr. Walker's own term, to reduce the mortality amongst them.

I voted against Mr. Walker at the 1910 conference on the question of carrying out improvement fellings for all classes in all the forests. Limited however to trees of say 4' girth and upwards, I am prepared to admit that it could be done with our present staff to an extent that would have an appreciable effect. Whether we could get round in such a short period as 10 years is another matter. For a start at any rate it could be done annually over all areas in reserves in which girdling is carried out. Given extra coolies it would not delay matters much for girdling officers to look for and free every teak tree over 4' in girth in the compartments being girdled over. The important point would be the limitation (except in special cases) of the cultural operations to poles and bigger trees. This would get over the difficulty with bamboos.

4. More than one forester with whom I have discussed the subject takes exception to my statement (paras. 4 and 31) that regeneration is all that has hitherto been thought about in bringing areas under fire-protection in Burma. This statement may be too sweeping. I based it on the ideas that I brought with me from the United Provinces. Whether I correctly reflected the views of other officers may be open to question, but I had firmly fixed in my mind the idea that in selection-worked forests regeneration is essential everywhere, and that this can be got (for *sal*) in abundance by protection from fire.

So long as protection is held to be good for regeneration the question at issue does not arise. It is only when the value of fire as an aid to regeneration is recognised that the claims of standing timber come to the front. I cannot remember any other case in which foresters have been called upon to weigh the balances between two such conflicting interests, in both of which they

are so vitally concerned. Before the balance can be struck at all we must make up our minds about both factors. It is a mistake to put down to fires all the damage we find done to standing trees and timber. So far as I can remember no systematic attempts to assess the damage by fire have been published except, some years ago, by Mr. Rodger, (*Indian Forester* for August 1904 and January 1907). Surely the matter is of sufficient importance to call for more extensive investigation. Every girdling officer could do it annually in a few compartments. Every Timber Assistant could do likewise. The argument is not weakened by want of practice on my own part as a D. F. O. The latter can be put down to lack of initiative, which could have been remedied by a standing order.

I have seen a good deal of both teak and pyinkado fellings. The opinion I have formed is that fires do not cause anything like so much damage as is commonly supposed. Decay travels much faster downhill than up. Winds, by tearing off branches, do an enormous amount of damage, for they let in the seeds of decay. Fellings themselves are answerable for a great deal. So also are creepers and epiphytes.

5. An error into which Mr. Walker falls is to mix up age and girth classes. On page 588 he states that distinct age-gradations do not exist, although, according to me there must be breaks in the series, corresponding with the intervals between successive flowerings of the prevailing bamboo. As no attempt has ever been made to count rings on all the stems (big and small) in any given area, proof that I am wrong is altogether wanting. It is true that girth-classes do not show any such breaks in the series, but this proves nothing. If trees of equal age may differ considerably in size, it is obvious that trees of the same size may differ greatly in age. A striking example is given on page 11 of my Memorandum on Teak Plantations in Burma which was published as Forest Bulletin No. 2 of 1911. The girths of 12 dominant stems in a 32-year old plantation are given. The largest equals 5′8″, the smallest equals 3′4″; a difference of 2′4″ in 32 years. It is hard to tell such a plantation from natural forest.

6. It comes somewhat as a pleasant surprise to find that Mr. Walker does not look with disfavour on the extension of plantations. It is rather rare to come across an officer who is keen on them nowadays. A great pity, because they are full of interest and any one who has really studied them must be certain that they are a sound financial investment.

Now that I have seen a bit of Arakan I am as hopeful as Mr. Walker is of the possibilities for teak plantations there, but—and a big but—I do not for a moment subscribe to the statement that " Pyinmana seems most unsuited for them," and that "plantations are for the richer divisions a thing of the past, as they have been tried and found wanting". This is a palpable exaggeration. The forests in all our rich teak-bearing divisions are honeycombed with areas devoid of teak, and yet, for all we can tell, suitable for its growth. Neglect of them in favour of Arakan would not help the latter appreciably. It is not on account of its growing area under plantations that Pyinmana is "gay with forest officers." Girdling absorbs them.

Time and space forbid me to enter at length into any more of the points raised by Mr. Walker. My letting them stand over does not mean that I attach little or no importance to them. Conversion to the Uniform System badly needs further discussion. I, for one, want to see it introduced, because of the manifold advantages of concentration, but I own to being unable to defeat the argument that it will involve a reduction of the yield in the first rotation. Perhaps some one will take the matter up.

Germination of teak is another point that we are still very much in the dark about. Why is it that seed dibbled or scattered broadcast in an opening in the forest does not come up as readily as if we cut the jungle down and burn it ? I do not subscribe to the idea that the growth of a teak seedling is " very erratic " from a scientific point of view. It simply means that we have not yet discovered the laws which govern it.

viâ RANGOON : F. A. LEETE,
27th February 1913. *I. F. S.*

NOTE ON THE POSSIBILITY OF EXPORTING PYINKADO SLEEPERS FROM BURMA FOR THE USE OF INDIAN RAILWAYS.

Up to date only a very small number of Pyinkado sleepers has been exported from Burma. This is not due to the fact that there is an insufficient quantity of this timber available but to other causes, the most important of which are—(i) the difficulty of extracting a species of timber which will not float and the want of lines of communication other than floating streams, (ii) the demand for cheap sleepers by the Burma railways, (iii) the cost of railing sleepers to Rangoon and (iv) the high prices obtained for Pyinkado scantlings and rafters in Burma, especially in Rangoon.

With reference to the first mentioned difficulty, a commencement has lately been made by the Upper Burma Wood Company to extract Pyinkado from the Yeni Reserve in the Pyinmana Division. A light steam tram line has been laid down from Ela station to the forest, a distance of 12 to 14 miles, and an up-to-date saw-mill erected at Ela. Whether this new Company will be a success remains to be seen, as the capital expenditure seems to have been somewhat excessive. In many cases the larger timber firms in Burma are carefully watching the results, and it depends much on the success of this undertaking whether the Pyinkado business expands or not in the next few years. There has also been a strong tendency on the part of local native saw-mill owners to extract Pyinkado, generally by carting, which has somewhat changed the position of affairs as regards the supply of sleepers to the Burma Railways. Two years ago the Burma Railways were distinctly short of sleepers, whereas now it is said that they have upwards of three lakhs of sleepers ready to lay down. One point is certain and that is that until the Burma Railways have an adequate and steady supply of sleepers available there will be strong opposition to any export trade.

The exact demand for renewals by the Burma Railways is not known, but it must be between a lakh and a lakh and a half yearly. The general condition of the sleepers in the line is in

many sections poor and it is understood that the Company intends improving the permanent-way very considerably in the near future. The result of this will be a proportionately larger demand for sleepers during the next few years, besides which the new line being constructed to the Southern Shan States will also raise the demand. The price offered for M. G. Pyinkado sleepers of the first quality is Re. 1-12 or roughly Rs. 56-8 per ton and for second quality sleepers Re. 1 each. It is said that a mill run on economic lines, always provided the rejections are not excessive, can be worked at 10 per cent. to 12 per cent. profit, and that if the number of second quality sleepers turned out is in any way excessive that the mills run at a loss. In any case the profits from this class of work are extremely small.

The cost of railing sleepers from up-country to Rangoon is a point which has been much discussed by persons interested in the business. Some misapprehension exists on this point. There seems to be an impression that the Railways charge double freight on Pyinkado to guard against export which would send up the price of local sleepers. This is not the correct state of affairs. The Railways do charge more per mile for railing Pyinkado than they do for 'In' or Teak, when calculating per cubical contents. The freight rates are based according to the weight of the various timbers, thus 32 cubic feet of Pyinkado, 40 cubic feet of 'In' and 45 cubic feet of Teak and other species are calculated as making a ton, and this is approximately right, looking to the weight of the different species. The Railways disregard the fact that "when converted material is loaded in a truck" space must be left between the scantlings, rafters, etc., and they calculate the weight by multiplying the height by the breadth by the length and calling it solid timber. The actual charges are arranged on a sliding scale. With the exception that 1 anna 3 pies per mile is the charge for 100 Viss. (360 lbs.) between Katha and 150 miles each side of that station and on the Lashio line, the general rates are 6 annas 9 pies per 100 Viss. for 10 miles or 8·1 pies per 100 Viss. per mile, reducing according to distance to Rs. 6-4-3 per ton up to 300 miles and over or ·64 pies per 100 Viss. per mile.

The last difficulty in the way of exporting Pyinkado sleepers from Burma is caused by the high rates ruling for converted material of this class in Rangoon. The present prices (January 1913), for rafters, scantlings, boards and planks is from Rs. 75 to Rs. 80 per ton, calculated at 50 cubic feet to the ton. Estimating the cost of Pyinkado B. G. sleepers landed in Rangoon at this price, their value is Rs. 5 each or about as much as the railways would pay for them landed in India. It is true that in converting scantlings, boards, etc., the labour of sawing and the loss in conversion is greater than when preparing sleepers ; on the other hand were a firm given the option of preparing B. G. sleepers or small constructional material the chances are they would find it more profitable to saw up the latter class of timber. In other words the price of Pyinkado timber is dangerously near being too high to make sleeper extraction profitable. It might be argued that as local saw-mills are ready to supply the Burma railways with M. G. sleepers at Re. 1-12 each or, in other words, at Rs. 56-8 per ton they would be only too ready to supply B. G. sleepers at Rs. 75 per ton. On the other hand it is partly due to the force of circumstances and to the cost of railing converted timber to Rangoon that they are willing to work M. G. sleepers delivered up-country. No doubt this is an economically unsound state of affairs, but the same would hold in the case of the export of B. G. sleepers though to a smaller extent, always provided that the market in Rangoon could absorb the quantity of scantlings, boards, etc., offered to it. Again, it might be argued that the local markets might become over-stocked, but even then there is an excellent market for that class of timber awaiting development in Calcutta.

From what has been said above it is evident that the export of Pyinkado B. G. sleepers is not as simple a matter as it might at first sight appear to be, nevertheless the position of affairs will require careful watching in the future. Were the Burma railways to find themselves able, during the next few years, to obtain their requirements at Re. 1-12 per sleeper, it is not improbable that they might be in a position to reconsider their freight rates, in order to encourage the carrying of timber on their line. This would have

the tendency to lower the local rates for converted material in Rangoon, partly owing to the reduced cost of railing but more especially on account of the fact that larger quantities of this class of timber would be available. Thus assuming that the price of sleeper-timber in India will remain constant, if it does not actually rise, and a rise in price appears not improbable, the economic position of affairs would be altered if not reversed, and the export of Pyinkado B. G. sleepers made a very profitable undertaking.

R. S. PEARSON,
I. F. S.

The Shri Swami Press, Dehra Dun. Photo by T. B. Chitrakar.

ANDROPOGON HALEPENSIS, BROT.

A NOTORIOUS INDIAN FODDER-GRASS.

The first claim to interest possessed by the common grass *Andropogon halepensis*, Brot (= *Sorghum halepense*, Pers.), the subject of the present note, lies in the fact that it is believed to be the wild form from which the well-known *juār*, *Andropogon Sorghum*, Brot (= *Sorghum vulgare*, Pers.) has originated by cultivation. As the characteristics of the wild form might be expected to survive to a certain extent in its cultivated offspring, it is advisable in the first place to briefly consider the properties of the cultivated plant which has been more carefully studied than the wild form.

As early as 1820 Roxburgh, in his *Flora indica*, speaks of the *juār* as follows: "The grain is much used for food. It is probable that through the whole of Southern Asia as many of the inhabitants live on the various kinds of dry or small grain, as upon rice, and they are reckoned fully as wholesome as that is. All kinds of cattle are remarkably fond of the straw notwithstanding its thickness and solidity." Sir George Watt, writing nearly a century later, says that the grain, "after rice, is perhaps the most valuable single article of food in India," while "its stems constitute the chief cattle fodder (*chari, karbi*) of a large portion of India. * * No other crops can compare with the Sorghums in yielding a heavy weight of green fodder of good quality. Succulent fodder of this class is especially valuable in the hot weather for all farm animals."*

* *Commercial Products of India*, by Sir George Watt, 1908, pp. 1031, 1039, 1040.

Against this fine record has to be set the undoubted fact that under certain circumstances juar fodder is found to contain prussic acid and is then poisonous to cattle. In Egypt it has been found that the amount of prussic acid is at a maximum when the plants are about 12 inches high, after which it gradually disappears as the plant matures—(Sir George Watt, *l. c.*, p. 1041). On this important point the following passage is sufficiently interesting to justify quotation in full : "There is some danger of poisoning the animals fed on any species of *Sorghum* which has been cut when only a few feet high after a long break in the monsoon. * * After a shower of rain it is again safe to issue it. Animals which have been fed on the poisonous plant die very soon with symptoms resembling tympanitis ; in some cases animals have died within 20 minutes of eating the fodder. An instance occurred on the Allahabad Farm when sheep, which were hired for purposes of stock manuring, were at the request of the owner turned on to graze an aftermath crop of *Sorghum vulgare*. Eight of the sheep died within a few minutes, and many more were saved merely by the rapid administration of purgatives. During lengthy breaks in the monsoon, when the *Sorghum* thus becomes poisonous, * * there is danger of grass-cutters bringing in some of the small plants of the *Sorghum* when *chiling* grass from among the crops. At Allahabad, in the summer of 1896, a number of horses belonging to private individuals died from this cause. The season was an exceptionally dry one ; in fact the monsoon failed and the crops being stunted and partially withered, the grass-cutters were allowed by the ryots to take grass from the juār fields.*

Turning now to the wild *A. halepensis* we find its poisonous properties strongly emphasised in Indian literature, as will be seen from the following :—

"Various reports however indicate its injurious effects on cattle if eaten when too young, or when the plants are stunted by drought. * * Dr. Stewart was told in Hazara that cattle, after eating it, are often attacked by fatal head affections. In Gujranwala, Gujrat and Shahpur districts it is said to be poisonous

* *Farm Manual*, by Major A. C. Williams and Major D. J. Meagher, 1903, p. 59.

until the rains are over, when cattle eat it with impunity "—(*Fodder Grasses of N. India*, by J. F. Duthie, 1888, p. 41). "If this grass is grazed when quite young, say 6 inches to one foot high, before the flower has developed, and when it is suffering from drought it is said to be sometimes poisonous, and to be fatal to cattle "—(*Grasses of the South Punjab*, by W. Coldstream, 1889). "The name *bikhonda*, given to *S. halepense* in certain mountainous countries, may be intended to denote its evil reputation "—(Sir George Watt, *l. c.*, p. 1031). As regards the fodder-value of this grass it does not appear, as yet, to enjoy a first class reputation in India, although it is considered to be good fodder. It seems probable that its importance in this respect has been somewhat overlooked, partly on account of the poisonous properties noted above and partly on account of the generally coarse appearance of the species (it attains a height of 15 feet) which is not calculated to attract the attention of casual observers to the grass as a possibly valuable fodder.

The following extracts indicate its present reputation in this respect :—

"Is considered to be a good fodder-grass both for grazing and as hay "—(Duthie, *l. c.*, p. 41.) "Grazed much and is relished as sweet * * said to remain good in stack five years * * is said in Gurdaspur district to be good for horses "—(Coldstream, *l. c.*) "Grows all over the Deccan, Gujrat, Dhulia and Bassein, where it is considered to be a good fodder-grass for cattle "—(*Bombay Grasses*, by J. C. Lisboa, 1896, p. 75).

"Grows abundantly in Bundelkhand and the Central Provinces. Resembles guinea grass in appearance * * grows best in rich soil * * produces an abundant crop, and is usually ready for cutting before any other grasses. On manured land without irrigation it yields from 8—10 crops annually." "When chaffed this fodder is much relished by cattle, but should be sparingly fed to milch cattle, as, like guinea grass, it is somewhat heating. It does not make good hay alone, but may be made into hay when not more than 3 feet high along with other grasses. It makes first-rate silage.—(Williams and Meagher, *l. c.*, p. 53).

From the Ramnagar Division of the United Provinces the grass has been recently reported to be "used as elephant fodder and in scarcity for cows and buffaloes."

This grass is said to have been introduced into N. America about 1830—40. It is now widely distributed in the S. States where it is generally known as Johnson-grass. In N. America it is considered to be more hardy and more valuable for hay than the well-known guinea grass (*Panicum maximum*, Jacq.) which is often cultivated in India for fodder—(see *Agricultural Journal of India*, Vol. V, 1910, p. 362, where the importance of this grass in India has been recently emphasised)—and it is remarkable that in the American literature no allusion seems to be made to its poisonous properties. In America, while on the one hand the grass enjoys a higher reputation as a fodder than in India; it is, on the other hand, much dreaded in that country as an exceedingly troublesome weed in agricultural land, as is indicated by the following extracts:—

"Johnson-grass is a rich land grass. It is at the same time the most highly praised and the most severely condemned grass found in the South, and both opinions have ample foundation. * * Its greatest value is as a hay grass, and for that purpose it cannot be excelled. * * The hay is coarse and not attractive in appearance, but stock of all kinds eat it greedily, seeming to prefer it to any other hay. * * Horses and mules prefer it to any other. * * The serious objections to its cultivation are the great difficulty of destroying it when the land is wanted for other purposes and the ease with which it spreads to fields where it is not wanted. In many localities it is the worst weed with which the cotton planter has to contend. * * Practically, it is never completely destroyed when once established on a favorable soil, and the farmer who plants it should do so only after careful consideration and with the expectation that it will remain on the land for ever."—(*Report on Forage Plants of the Gulf States*, by S. M. Tracy, 1898, U. S. Dept. Agric. Bulletin No. 15, pp. 22, 27). "In the warmer parts of the Southern States it makes rapid growth, is but little affected by drought, and the hay, if cut just as the grass

is coming into bloom, is much liked by all kinds of stock. * * This grass, when once it has become established, is exceedingly difficult to eradicate, and hence has come to be greatly feared by the majority of farmers."—(*Economic Grasses*, by F. Lamson-Scribner, U. S. Dept., Agric. Bull. No. 14, 1900, p. 13).

This grass, therefore, merits careful attention in India, both on account of its occasional poisonous action and the possibility of its being the cause of various obscure cases of illness and death of cattle, ponies and horses during the rains, owing to the carelessness of graziers and grass-cutters, and also on account of the high esteem in which it is held for fodder purposes in America. Information is especially required regarding the distribution, local prevalence, vernacular names and local uses of the species in different districts, and it is in the hope that Forest Officers may take an interest in the subject that this paper has been written. The grass is common in moist grasslands both in forest areas and in cultivated land more or less throughout India, ascending to 7,000 feet; it extends to Burma, China, Australia, Ceylon, Kashmir, the Mediterranean and Africa. The local Indian vernacular names of the grass, so far as they are known at present, are as follows :—

Kashmir—brahām.

Punjab—baru.

United Provinces—baru, mangaria (Ramnagar); chari (Haldwani); bikhonda (Kumaun); bājra, barru, bara (Banda); bharwi.

Bengal—kāla-mūcha, baru.

Central Provinces—baru (Betul); galla jāri, padda jalla gadi (Chanda); jondhri, boru (Yeotmal); baba jara, podar jara (Melghat); bhurru (Nimar); kartāl (Berar).

Bombay—barru, bara, boru, kartal, dacle, batal, narvas, bhondu.

Madras—kodyapul, gaddi janu.

Burma—myet kha ywa.

R. S. HOLE,
Forest Botanist.

NEEM TODDY.

In the December issue of the *Indian Forester*, Mr. Allen brought to the notice of its readers the fact that leprous persons eagerly take the exudation of *Neem* as a remedy against the hateful malady. This belief is of very old standing, and has in fact originated from the old medical literature of the Hindus. There can be no doubt about the fact that the leaves and bark, and also the oil out of the seeds, have specific medicinal properties. Dr. Watt in his Dictionary of Economic Products has collected opinions of various medical men, both European and Indian, about the medicinal properties of the different parts of this tree. From all these it can easily be gathered that the bark is a good febrifuge, and is especially useful in periodic fever, also in thirst and nausea. The leaves as well as the oil are very useful in skin diseases. They are also a germicide and an antiseptic. Since so many parts of this tree are medicinal, specially when some of them have specific action on the skin, it is but natural that people should ascribe some valuable medicinal properties to its spontaneous exudation. It is not every day that the *Neem* begins spontaneously to exude the toddy, and therefore the rarity of the occurrence adds a good deal to the importance of this product in popular estimation.

A sample of toddy received from Rai Bahadur Har Swarup, Conservator of Forests, Gwalior State, was chemically examined to find out its constituents and to ascertain whether there is any active principle that might produce the effects popularly ascribed to it. The toddy was a milk-like whitish emulsion with a pale yellow tinge. It was sweet in taste and possessed the peculiar aromatic odour of full ripe *Neem* fruits. On boiling and removing the precipitated albuminous matter, a limpid faintly yellow solution was obtained. Angle of rotation of this solution at 15°C was +11°C. Its specific gravity at the same temperature was 1·0589.

The following is the general composition of the material:—

Moisture	86·56	per cent.
Proteids	0·36	"
Gums and colouring matter ...	6·17	"
Glucose (grape sugar)	2·99	"
Sucrose (cane sugar)	3·51	"
Ash	0·41	"

Petroleum ether extracted from the dried solids of the toddy only a trace of fatty and resinous matter. Tests for alkaloidal and glucosidal principle were in the negative.

Qualitative analysis of the ash showed the presence of potassium, iron, aluminium, calcium and carbon dioxide in it.

From the above analysis it can easily be seen that the toddy cannot claim any special medicinal properties. It is, like all other toddies, a syrupy solution of sugar, plus a little albuminous and gummy matter with the peculiar odour of ripe *Neem* fruits. The valuable active principle of *Neem* which is an alkaloid according to Cornish and a resinous body according to Broughton (*vide* Watt's Dictionary of Economic Products), is absent. Hence the *Neem* toddy can be said to be a cooling nutrient and stimulating tonic, but it does not seem to contain anything which can be said to be useful for leprosy or other skin-diseases.

Dr. Watt also mentions the tapping of *Neem* for its toddy. This is not a general practice, but if it can be successfully tapped, and if it is made available in large quantities, then it might be a fruitful source of country liquor or even alcohol, and in that case the tree might well be brought under the Excise Act.

This investigation was carried out under the instructions of the Forest Chemist.

T. P. GHOSE, B.Sc.,
Assistant to Forest Chemist.

NOTES ON THE LIFE-HISTORY OF *CYRTOTRACHELUS LONGIPES.*

Notes on the Life-history of *Cyrtotrachelus longipes* (C. longipes, Fabr. Spec. Ins. I, page 162 = *C. longimanus*, Fabr. Syst. Ent. App., p. 822).

References.—" Departmental Notes on Insects that affect Forestry," by E. P. Stebbing, Part II, pages 193—197.

" Manual of Forest Zoology," by E. P. Stebbing, page 102.

Lefroy s " Indian Insect Life," page 391.

It is unnecessary for me to describe this insect, a complete description of eggs, larva, pupa, and imago being given in the references quoted above, together with a plate showing the grub, perfect insect, and form of attack. Suffice it to say that this insect belongs to the *Curculionidæ* family of the order Coleoptera.

The subject of its attack is the bamboo *Dendrocalamus strictus*, Nees.

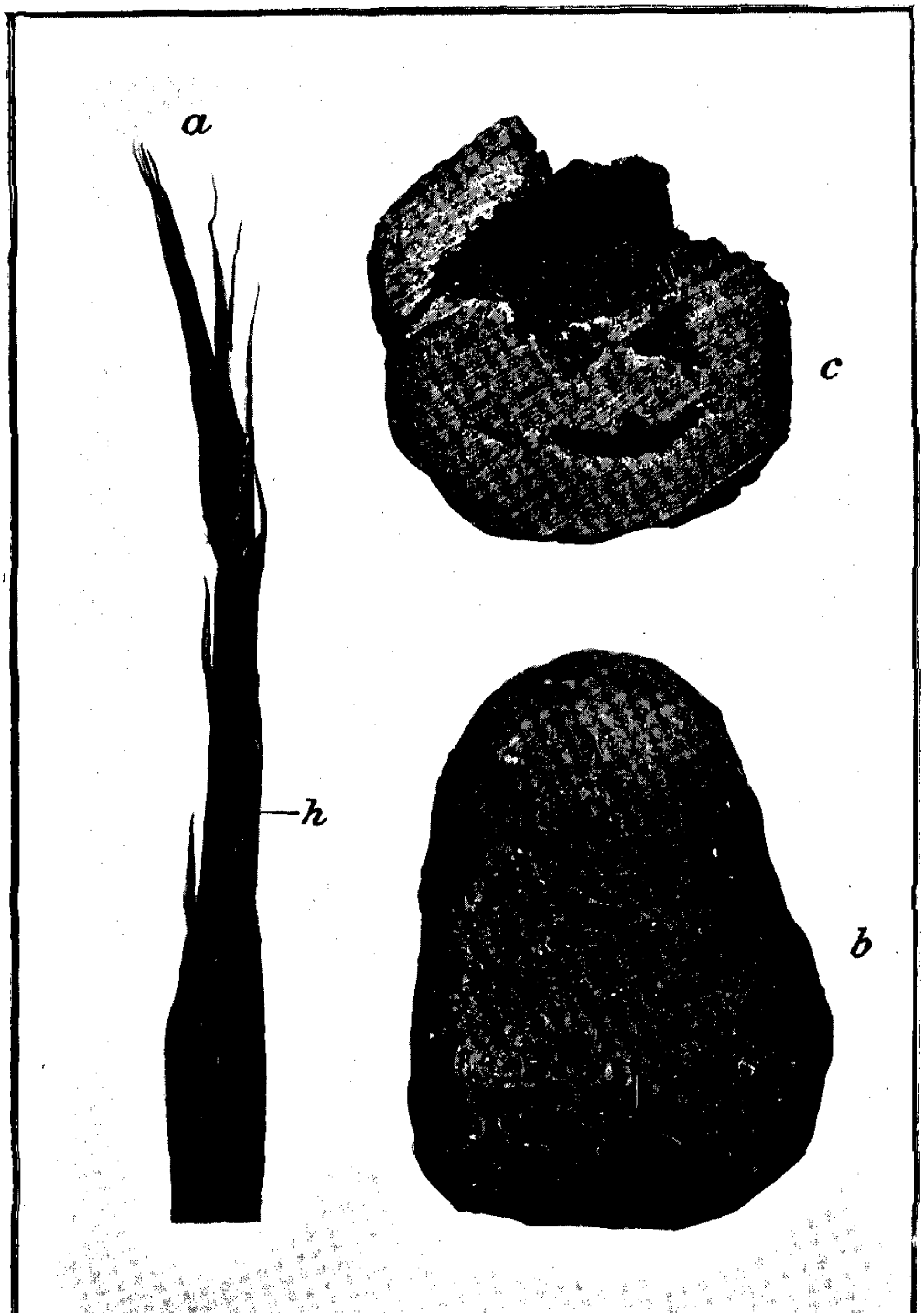
So far as I am aware, these observations are the first that have been made regarding the insect's attack on *Dendrocalamus strictus*, it having been previously recorded only from *Melocanna bambusoides*, Trin.

The beetle was first noticed by me during the rains of 1910. It was then observed attacking the new bamboo shoots which appear in July and August. Specimens of the perfect insect were sent to the Forest Zoologist, at Dehra Dun. The beetle was finally identified as *Cyrtotrachelus longipes*, F. In the meantime I had been working at the life-history of the insect, though not with any great success. What becomes of the full-grown larva and where it pupates, evaded detection for some time.

As soon as the beetle was identified its life-history as given on pages 194—196 of "Departmental Notes on Insects that affect Forestry" became available. I thereupon set to work to follow it out on the same lines. It was while doing this during the rains of 1911 that several facts in the life-history came to light, showing considerable divergence from those recorded by Mr. Stebbing.

It is with the object of placing these on record and showing how the life-history of the insect as worked put by me differs from that recorded by Mr. Stebbing that this note is written. The locality where the observations were made is the Gharakota Reserve of the Saugor Forest Division in the Central Provinces. The area of the Reserve is 2,795 acres, of which about 700 acres have been artificially stocked with *Dendrocalamus strictus* planted in 1875, 1880-81, and subsequent years.

Life-history—The beetles appear about July or August, depending on the state of the monsoon. If the rains are early



The Shri Swami Press, Dehra Dun. Photo by T. B. Chitrakar.

CYRTOTRACHELUS LONGIPES, Fabr.

Fig. (a) The letter *h* indicates the position of the exit-hole.
„ (b) Earthen cell, entire. Fig. (c) the same in section.

and sufficiently heavy to moisten the soil to some depth, the beetles may be seen already towards the end of July. Otherwise they do not appear until the middle of August. The chief thing to note is that the appearance of the beetle coincides with the sprouting of the new bamboo shoots on which the eggs are laid. In 1911 the beetles began to appear during the first week of August. Subsequently they were found by me on the 19th, 20th, and 21st August, and throughout the month by the Forest subordinates.

One found on 19th August, was observed coming out of the ground near the base of a bamboo clump. It was working its way out backwards, but whether this is the normal manner of its emergence I am unable to say. This year, owing to a late monsoon, the first beetle was not observed until 20th August, and up to this date very few bamboo clumps had sent out new shoots. The beetle is on the whole very sluggish and appears to fly about in search of the new shoots only towards the evening.

Mr. Stebbing states that " Shoots attacked are always under 3 feet in height." This is not quite correct. In 70 per cent. of the shoots attacked it is probably true. But I have found the insect on shoots 6—8 feet high and frequently have seen shoots alive up to 10 and 12 feet from the ground with the top destroyed by the larva.

Egg-laying.—The eggs are not necessarily laid just above an internode as stated by Mr. Stebbing. I have found them at practically any part of an internode. Nor are they always laid in pairs in the same oval incision. More frequently two incisions, close together, will be found with an egg at the base of each. The eggs are seldom visible from the outside, the incision being made through more than the outer spathe* and the egg well hidden at the base of the hole. As regards the number of eggs laid by the female, on which point Mr. Stebbing lays great stress, my observations go to show that they vary from 2 to 4. All are laid on the same day. The eggs hatch out in from three to five days.

* For *spathe* read *culm-sheath*.—HON. ED.

The following observations were made by me on the above points :—

Date of egg-laying.	No. of eggs laid.	Date of hatching.	REMARKS.
6th September 1912	2	1 on 9th September 1 on 10th "	Each egg in a separate incision.
Ditto ...	2	1 on 11th September 1 failed to hatch ...	Each egg in a separate incision.
Ditto ...	2	Both failed to hatch	Each egg in a separate incision.
Ditto ...	3	3 on 11th September	Larvæ worked down to first node, then turned on 15th September and began working upwards. On 20th September one larva was ¼" in length. Each egg in a separate incision.
7th September 1912...	*4*	*Eggs got damaged* and failed to hatch.	*Two eggs in one incision.*

Larva.—The first point to note is that it is quite incorrect to say that only one larva is to be found in any one attacked shoot. On 21st September 1911 I found three nearly full-grown larvæ in one shoot, and two in another shoot. These are instances actually recorded by me at the time, but of the numerous affected shoots which have passed through my hands the majority contained more than one larva.

The larva on hatching out does not at first bore horizontally through to the centre of the shoot as imagined by Mr. Stebbing, but rather in a slanting direction inwards, and not always downwards, with the result that it does not reach anywhere near the centre of the shoot until it is at least half-grown. I have before me as I write this a case in which the larva now ¼ inch in length has worked its way 1½ inch directly upwards under the cover of two spathes only. The actual distance of the larva now from the extreme tip of the shoot is 10½ inches. I do not think it will ever turn and work downwards. Should it have started downwards, it soon turns and works its way up again still

growing until it reaches a point which on the average is from 6 to 9 inches from the extreme tip of the shoot. Mr. Stebbing states, "It continues feeding downwards until it reaches the base of the shoot."

This would imply that it invariably bores down to the ground level. Such, however, is not the case. On the contrary, with the exception of those instances in which the point of attack is very close to the ground, the larva never by any chance reaches the base of the shoot. The larva being now full-grown according to Mr. Stebbing, cuts off the top portion of the shoot "gnawing it through all round below him." In no instance have I found this to be the case. My observations show that the larva works its way to the surface of the shoot and emerges through a large round hole which is clearly visible, and thence falls to the ground. I was a little doubtful about this at first, but while searching for larvæ in September 1911 I found quite a number of new culms, the tops of which were dead, and all containing large round exit holes within 6 to 9 inches of their tips. These tops do eventually fall off from natural decay, and are then found at the base of the bamboo clumps, but they are not cut off by the larva itself. I further tested this by keeping some tops, about 18 inches in length with larvæ in them, under observation. One such top found on 25th September 1911 contained two larvæ almost full-grown. On 28th September one of these larvæ worked its way out to the surface during the night and was found early in the morning. The second larva worked its way out during the night of the 29th. In each case a large round exit hole was found in the top which was otherwise intact. This particular top* is now in the Forest Zoologist's collection at Dehra Dun. The length of time passed in the larval stages has not been studied by me in full detail, but appears to be about three weeks. One larva which hatched on 11th September was found to be $\frac{1}{4}$ inch in length on 20th September. Another larva found when about

* Thanks to the kindness of Dr. Imms, B.A., Forest Zoologist at the Forest Research Institute, who has had this top photographed for me I am able to reproduce the same here—see Fig. (a) of Plate 5.

¼ inch in length on 4th September was full-grown and emerged on 13th September.

Pupa.—The larva having fallen to the ground its next procedure is to bury itself in the ground. Mr. Stebbing writes: "The larva changes to the pupal state within the fallen buried "end of the shoot at a depth of 3 to 4 inches or even more, below " the surface of the ground, the depth depending on the consistency " of the soil. The top of the shoot soon rots, only the harder fibres " persisting. Inside this fibrous covering which is generally caked " with earth the pupa remains during the cold and hot seasons."

This statement requires some amendment. Though I have repeatedly searched and had search made for the pupæ in the ground, I have not been very successful in finding them. I have only actually dug up two myself while ten more have been found by Forest subordinates and brought to me. The two obtained by me were found by tracing down into the soil the course of round holes of the circumference of the full-grown larvæ which were noticed after scraping away the fallen leaves and *débris* under bamboo clumps. In the first instance the pupa was found at a depth of 9 inches from the surface, lying on its side embedded in an earthen cell which, be it noted, contained absolutely no fibres in its constitution, nor any trace of the bamboo tip from which it had emerged. In the second case a full-grown larva, not yet pupated, was found 10 inches below the surface in a cell consisting largely of pieces of bamboo fibre. It does not, however, follow that this was necessarily the remains of the bamboo tip from which the larva emerged, and from my observations of the manner in which the larva does emerge, I am of opinion that the fibres are gathered together otherwise. Judging from the hole made in the ground by the larva, it is difficult to understand how the shoot end could be dragged down into the ground by it. The pupæ collected by Forest subordinates are reported to have been found in each case about 9 inches from the surface of the ground. It is quite certain, therefore, that the average depth to which the larva burrows is considerably more than 3 to 4 inches. Were this not the case the pupæ would be much more easily found than they are. My observations further go to show that the normal form of cell in

which the larva pupates is an earthen cell and contains no trace of bamboo fibres in its composition. With a view to ascertain this, and with the intention of finding out how long it took for the larva to pupate, I had search made in the ground for the still unpupated larvæ, and when discovered the whole cell dug out complete and brought to me. This was done on the 24th, 25th, 26th and 27th September 1912. Nine pupal cells were brought to me intact, the entrance hole closed up with a plug of earth. On 29th November I opened these cases. Unfortunately in every case the larva had died, and was in a shrivelled condition. I imagine this was due to the clod of earth surrounding the cell drying much more rapidly than would have been the case had it remained below the surface of the ground. I was more fortunate with the one found by me in a cell consisting mainly of bamboo fibres already referred to. This I dug up on 27th September 1911. It was then still in the larval state. I opened it again on 12th October, when it was found to have pupated. A second larva which had emerged from a bamboo shoot, kept under observation, and which immediately burrowed into the earth provided for it, was examined 15 days later, and was found to have taken on the pupal form, though still covered with the larval skin. It appears, therefore, that the larvæ take about a fortnight to pupate. As regards the form of the nine pupal cells referred to, in every case the cell was found to consist of a smooth earthen cell,* somewhat oblong in shape and slightly larger than the larva itself. In no instance could I find any trace of bamboo fibres in its composition.

In this cell the pupa remains until the following July or August when it emerges as the perfect insect thus completing the cycle. This is graphically shown as under :—

January.	February.	March.	April.	May.	June.
••••	••••	••••	••••	••••	••••

*One of these earthen cells, whole and in section, is depicted in Figs. (b) and (c) of Plate 5.

July.	August.	September.	October.	November.	December.
●●+ +	+ + + + ○ ○ ○ — —	+ — — — ○ —	●●●●	●●●●	●●●●

Egg	.. ○
Larva	.. —
Pupa	.. ●
Imago	.. +

Protection and Remedies.—From the foregoing remarks it is clear that the method of digging up the pupal cases and burning them, as suggested by Mr. Stebbing, is not at all satisfactory. It is a laborious method owing to the depth to which the larvæ burrow and the difficulty experienced in finding the pupæ. The surest and undoubtedly the best and most economical method is to watch for the appearance of the perfect insect. It is a large and conspicuous beetle and very sluggish. If, as soon as the beetles begin to appear, the young culms are continually examined, the beetles can be collected in considerable numbers and at little expense. It would also be advisable, whenever a beetle is found on a new culm, to examine that culm at once and destroy any eggs found on it. In the Gharakota Reserve this method of collecting the beetles has been resorted to with considerable success. Finally the collection of the fallen tops is obviously useless because none of them contain larvæ as has been supposed.

In conclusion, my thanks are due to Dr. Imms, Forest Zoologist, for much valuable advice in the preparation of this note.

CAMP DEORI : D. O. WITT,
16th March 1913. *Deputy Conservator of Forests.*

MEMORANDUM ON THE OIL-VALUE OF SOME FOREST OIL-SEEDS.

By Puran Singh, F.C.S., Chemist at the Forest Research Institute, Dehra Dun, United Provinecs.

A large number of specimens of the Forest oil-seeds received through the Forest Economist have been examined by the Forest Chemist from time to time, with the object of determining the percentage of oil in them and in some cases, the variation in the percentage of oil in the seed of the same species received from different provinces and localities. Thirty-eight different species have been tested. While this work was in progress, it was proposed to determine the chemical composition of the oils and the oil-cakes, the latter being prepared in the Laboratory by a small experimental hydraulic press, especially put up for this purpose.

The publication of Agricultural Ledger No. 5, "Oils and Fats of India," by Mr. David Hooper, Officiating Economic Botanist to the Botanical Survey of India in 1912, has supplied

in a very handy form much useful information to the commercial world on the different oils and fats in which are included most of the important forest oil-seeds also. The proposal to go into the chemical composition of the oils from forest oil-seeds was, therefore, abandoned, while the determination of the composition of the manurial value of the oil-cakes will be carried on by the writer in conjunction with the Forest Economist from time to time as opportunity offers, the chief consideration being the quantity of the oil-seeds that can be made available for commercial purposes at rates admitting of business. Only those oil-seeds will be taken up for a detailed enquiry, which will be found to occur in quantities sufficiently large for commercial purposes.

In special cases, a systematic investigation into the chemical composition will also be made.

This memorandum embodies the results of the tests of oil value of the different oil-seeds examined till now. The figures given represent the total fatty matter extractable by ether.

I.—Ægle Marmelos, Corr.

Only one sample of this seed was received from Kumaon. 100 seeds weighed 6·17 grams. The kernels gave 44·10 per cent. of oil, the kernels being 77·90 per cent. of the total seed and the shells being 22·10 per cent.

II.—Argemone mexicana, Linn.

Only one specimen of this seed was received from the Conservator of Forests, Southern Circle, Madras. 100 seeds weighed 0·21 grams, giving 37·66 per cent. of oil. In Agricultural Ledger No. 5 of 1911-12, it is stated that the seeds yield 25 to 30 per cent. of oil by ordinary pressure—a quantity equal to that obtained from rape seed. It is an orange coloured oil used for burning in lamps and is also employed by painters as a drying oil, and for giving a glistening appearance to wood. It is considered probable that its acridity is likely to prevent the attacks of white-ants and borers. As such, it deserves a trial.

III.—Balanites Roxburghii, Planch.

Seven specimens have been examined, with the following results :—

Name of the locality.	Weight of 5 seeds in grams.	Kernels per cent. of total seed.	Shells per cent.	Oil in kernels per cent.
1. Akola, Berar ...	97·42	11·97	88·03	49·12
2. Bombay	96·55	8·34	91·66	48·86
3. East Cuddapah ...	94·80	9·90	90·10	46·63
4. Nimar, C. P. ...	91·17	13·37	86·63	49·85
5. North Arcot ...	43·83	16·95	83·05	49·86
6. Sohagpur (Hoshangabad Division)	76·43	11·49	88·51	50·76
7. Southern Circle, Madras...	48·37	8·69	91·31	48·33

It will be seen from the above table that the oil value of the kernels varies between 46·63 to 50·76 only, while the shells are 83·05 to 91·66 per cent. of the total seeds. It is a slow-drying oil being similar to ground-nut oil.

IV.—Bassia butyracea, Roxb.

Only one sample of this oil-seed from Gonda was examined. 20 seeds weighed 16·10 grams, of which 74·53 per cent. were kernels and 25·47 per cent. shells. The oil in kernels amounted to 57·69 per cent.

V.—Bassia latifolia, Roxb.

Out of about twenty samples from different localities, only eleven specimens of this well-known seed were examined, the others having been received in a decomposed state.

The results are tabulated below :—

Name of the locality whence obtained.	Weight of 20 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.
1. Akola	41·50	72·81	27·19	41·80
2. Bahraich	32·72	68·21	31·79	48·89
3. Betul Division, C. P. ...	...	...	...	50·69*
4. Buldana	36·61	70·99	29·01	46·46
5. Chhindwara Division, C.P	37·91	68·90	31·10	38·48
6. Damoh, C. P. ...	...	...	...	49·09*
7. Gonda...	75·50	70·10	29·96	53·36
8. Jumna Range, U. P. ..	41·98	77·63	22·37	50·70
9. Kumaun	42·39	76·33	23·67	31·48
10. Nagpur	...	..	...	36·03*

VI.—Bassia longifolia, Linn.

Only two specimens of this seed have been tested, one from Southern Circle, Madras, and the other from Coimbatore, Madras. The first gave 54·60 per cent. of oil in kernels, and the second 55·27 per cent.

VII.—Buchanania acuminata, Turcz.

Only one sample of this oil-seed was received from Maymyo, Burma. Twenty seeds weighed 32·87 grams with 11·25 per cent. of kernels and 88·75 per cent. of shells. The oil in kernels amounted to 56·56 per cent.

VIII.—Bombax malabaricum, DC.

Only one sample of this seed from Coimbatore was tested. It gave 29·72 per cent. of oil in the total seed. 100 seeds weighed 5·54 grams.

IX.—Buchanania latifolia, Roxb.

Eleven specimens of this species were tested. The results are tabulated below. It will be seen that the oil in kernels varies

* Received in the form of kernels.

from 60 to 67 per cent., and the percentage of kernels in the total seeds varies from 19 per cent. to 33 per cent. Only in two samples, one from Buldana and the other from Maymyo, the percentage of oil is 45·64 and 42·41 respectively. The Burma seeds were much smaller, 100 weighing only about 15 grams, while the weight of 100 seeds from other localities varies from 21 to 40 grams.

Locality whence received.	Weight of 100 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.
1. Akola, Berar ...	21·36	19·86	80·14	61·55
2. Buldana	...	...	...	45·64*
3. Bundelkhand, Jhansi ...	40·94	19·35	80·65	67·83
4. Coimbatore... ...	26·00	33·49	66·51	67·94
5. Cuddapah	30·01	25·92	74·08	60·30
6. Gonda	33·69	22·00	78·00	63·65
7. Jubbulpore	25·3	32·00	68·00	67·50
8. Jumna Range ...	39·41	22·34	77·66	60·28
9. Kumaun	25·32	21·55	75·45	64·03
10. Nimar, C. P. ...	22·98	28·48	71·52	62·18
11. Rahatgaon	25·88	26·67	73·33	66·74

X.—*Butea frondosa*, Roxb.

Only one sample of this seed from Kistna (Madras) was tested. 100 seeds weighed 109·93 grams. The oil in total seeds amounted to 22·52 per cent.

XI.—*Cassia Fistula*, Linn.

A sample of this seed from Kumaun gave 56·26 per cent. oil in the kernels. Twenty seeds weighed 11·51 grams, having 55·52 per cent. of kernels and 44·48 per cent. of shells. It is said to be vailable in quantity in the Central Provinces. It is not yet known to have been utilised for any purpose.

* Received as kernels.

XII.—Celastrus paniculata, Willd.

Locality whence received.	Weight of 100 seeds in grams.	Oil in total seeds.
1. Bahraich	6·27	55·31
2. Betul C. P.	1·36	58·58
3. Buldana	1·38	58·11
4. Damoh, C. P.	7·51	60·01
5. Gonda	6·33	64·29
6. Kumaun	5·94	77·32
7. Lahore	9·64	59·80
8. Mandalay	10·52	61·49

This is a dark-red pungent oil. It is said to be a nerve tonic, and is applied externally to sores.

XIII.—Celastrus Senegalensis, Lam.

One sample of this seed was received from Amraoti, C. P. 100 seeds weighed 1·55 grams. The oil in the whole seeds amounted to 24·88 per cent. It is said to be found in large quantities in Rajputana and Berar.

XIV.—Cochlospermum Gossypium, DC.

Seven samples of the seeds were examined. The weight of 50 undecorticated seeds varies from 3·93 to 5·2 grams. The oil in the total seeds varies from 13·35 to 17·50 per cent.

Locality whence received.	Weight of 50 seeds in grams.	Oil in total seeds per cnt.
1. Akola, Berar	4·65	17·53
2. Betul, C. P.	4·48	17·58
3. Chhindwara, C. P.	4·37	17·41
4. Cuddapah	3·93	13·35
5. Nimar, C. P.	4·82	16·46
6. Sohagpur, Hoshangabad, C. P.	4·92	15·07
7. South Salem	5·24	15·41

XV.—Diospyros montana, Roxb.

One sample from Kangra (Punjab) was received. 100 seeds weighed 59·20 grams, of which 43·66 per cent. were kernels and 56·34 per cent. shells. The kernels gave 22·29 per cent. of oil.

XVI.—Heynea trijuga, Roxb.

One specimen from Surat gave 37·45 per cent. of oil in kernels. 20 seeds weighed 56·48 grams with 2·44 per cent. of kernels and 97·56 per cent. of shells.

XVII.—Hibiscus cannabinus, Linn.

The seeds of this plant have been frequently sent from India to England as an oil-seed. They are said, however, to yield only 15 to 20 per cent. oil by pressure, so in spite of their cheapness they are seldom crushed in this country. The oil is clear and limpid and though coarse, forms a good lubricating and illuminating material. Only one sample from Amraoti was received. It gave 40·14 per cent. of oil in kernels. 20 seeds weighed 17·65 grams with 62·15 per cent. of kernels and 37·85 per cent. of shells.

XVIII.—Hydnocarpus inebrians, Wall.

Only one sample from Coimbatore was received. It gave 64·15 per cent. of oil in kernels. 100 seeds weighed 93 grams, with 91·61 per cent. of kernels and 8·39 per cent. of shells. The oil is used as an external application in certain cutaneous diseases and has a special reputation in leprosy. It has been recommended as a substitute for Chaulmugra oil obtained from *Gynocardia odorata*.

XIX.—Hydnocarpus Wightiana, Blume.

The oil from these seeds is also said to be a substitute for Chaulmugra oil. The kernels alone are stated to give 32·4 per cent. of oil when subjected to hydraulic pressure. Only one sample of this oil-seed was received from Madras (Southern Circle). 100 seeds weighed 202 grams with 52·12 per cent. of kernels and 47·88 per cent. of shells. The oil in kernels amounted to 60·79 per cent.

XX.—Jatropha Curcas, Linn.

One sample from Coimbatore was tested. It gave 57·84 per cent. of oil. 100 seeds weighed 51·3 grams with 67·91 per cent. of kernels and 32·09 per cent. of shells. The oil is stated to be used

in medicine, for soap-making and burning purposes. It possesses considerable drying properties, which are not so good as those of cotton-seed oil.

XXI.—Melia indica, Brandis.

A fixed acrid bitter oil, deep yellow and of a strong disagreeable odour, is extracted from the seed by boiling or pressure. It is already manufactured on a considerable scale and forms an important article of export from Madras, chiefly to Ceylon. It is employed medicinally as an anthelmintic and antiseptic, and is also considerably used by the poorer classes for burning in lamps, but is said to smoke offensively.

Three specimens were tested with the following results :—

No.	Locality whence received.	Weight of 100 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.
1	Coimbatore	24·13	54·98	45·02	55·85
2	Damoh, C. P.	9·38	...	...	51·10
3	S. C. Madras	23·74	53·80	46·20	49·66

XXII.—Mesua coromandeliana, Wight.

One sample was received from Southern Circle, Madras. 100 seeds weighed 134·6 grams with 62·70°/₀ of kernels and 37·30 °/₀ of shells. The kernels gave 75·75°/₀ of oil.

XXIII.—Mesua ferrea, Linn.

Five different samples of these oil-seeds received from different localities were examined for their oil value. As will be seen from the table below, the oil value of the samples examined varies from 72 to 83 per cent. The seeds from Burma are better in quality than those from Madras. The ratio between the shells and the kernels in the Burma seeds is nearly 1·5 in the case of seeds from Mandalay and 1·4 in the case of Myitkyina seeds, while in the case of seeds from Madras it varies from 1·3 to 1·4. The oil value

too of Burma seeds is higher than that of Madras seeds, the former being 82—84 per cent. and the latter only 73—76 per cent.

No.	Locality whence received.	Weight of 20 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.
1	Coimbatore	48·73	77·27	22·73	74·86
2	Madras	46·69	78·87	21·13	72·52
3	Mandalay	25·78	82·79	17·21	83·68
4	Myitkyina	21·46	78·85	21·15	82·42
5	South Canara	51·73	79·45	20·55	75·79

XXIV.—Mimusops Elengi, Linn.

The results of the determination of the oil value of 19 samples of the oil-seeds of *M. Elengi* from different localities in the Madras Presidency are tabulated below. It will be seen that the weight of 20 seeds varies from 8 to 12 grams. The percentage of kernel in the seed varies from 38 to 45. Only two samples are abnormal, in one the kernel is 70 per cent. and in the other shell is 92 per cent.; the latter, however, was in the form of whole fruit. The general ratio between kernel and shell is about 1 : 1. The percentage of oil in kernels is nearly uniform in all samples, being 24 to 25.

No.	Locality whence obtained.	Weight of 20 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.
1	North Canara	10·63	41·39	58·61	23·27
2	Coimbatore	12·21	37·67	62·33	23·87
3	Coimbatore, Canara ...	8·52	44·64	55·36	24·24
4	East Cuddapah	7·50	44·30	55·70	25·30
5	S. C., Madras	59·80*	7·90	92·10	24·94
6	South Salem	7·20	70·14	29·86	23·76

* Including upper pericarp.

XXV.—Mimusops hexandra, Roxb.

Four samples were tested with the following results :—

No.	Locality whence obtained.	Weight of 100 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.
1	East Cuddapah	10·83	53·83	46·17	53·57
2	Madras (S. Circle) ...	...	...	...	53·37
3	North Arcot, Bombay ...	5·72	61·18	38·82	44·12
4	Thana, Bombay	14·64	51·29	48·71	49·46

From the above it seems evident that the seeds from Madras were richer than those from Bombay.

XXVI.—Myristica Farquhariana, Wall.

One sample from Coimbatore was tested. It gave 68·19 per cent. of oil in kernels.

XXVII.—Myristica malabarica, Lamk.

One sample only was received from Coimbatore. It gave 45·53 per cent. of oil in kernels.

XXVIII.—Phyllanthus Emblica, Linn.

One sample from Surat was received. 100 seeds weighed 74·10 grams, being 17·20 per cent. kernels and 82·80 per cent. shells. The kernels gave 12·69 per cent, of oil. The seed is very poor in oil, and it need not be considered as an oil-seed.

XXIX.—Prinsepia utilis, Royle.

One sample was received from Lahore. 100 seeds weighed 12·26 grams with 76·94 per cent. of kernels and 23·06 per cent. of shells. Kernels gave 53·30 per cent. oil.

XXX.—Pongamia glabra, Vent.

Fifteen samples of this oil-seed were tested as received from different localities. The kernels had a very thin covering which was not separated, while in some cases only kernels were received. This oil-seed can be had in large quantities, and it is probable that a good trade may be developed by exploiting it on a commercial scale.

No.	Name of the locality whence obtained.	Weight of 100 seeds in grams.	Oil in kernels per cent.
1	Betul	139·60	43·81
2	Buldana, C. P.	111·05	36·31
3	Chhindwara, C. P.	159·00	38·84
4	Coimbatore	176·64	40·50
5	Cuddapah	141·35	37·37
6	Cuddapah	100·95	38·85
7	Jubbulpore	136·22	35·44
8	Kurnool, East	154·60	44·45
9	Nagpore	162·80	39·80
10	Nandyal, W. Kurnool	129·80	41·22
11	Salem, South	140·15	36·11
12	Sohagpore, C. P.	140·65	38·62
13	Sohagpore (a different specimen from the above)...	155·75	36·29
14	Surat	127·95	36·25
15	Thana, South	127·80	37·99

XXXI.—*Prunus eburnea*, Aitch. et Hemsl.

A sample of this seed was received from Baluchistan. The weight of 100 seeds was 39·92 grams, of which 26·92 per cent. were kernels and 73·08 per cent. shells. The seeds were just like peach-stones, but much smaller. They tasted bitter with the bitter almond smell. The kernels gave 44·34 per cent. of oil.

According to an analysis of Messrs. A. Boake Roberts & Co., Ld., London, received by the Forest Economist in 1909, the seeds after having been allowed to ferment for three days yielded 0·11 per cent. of a volatile oil. This oil had a strong odour of almonds and prussic acid, and had the following characteristics :—

Refractive index at 20°C. ... 1·5208.
Sp. Gravity at 15°C. ... 1·039.

It contained about 6 per cent. of Benzaldehyde. It was suggested by the said firm that the kernels might prove a profitable source of an inferior quality of the oil of almonds.

XXXII.—*Quercus incana*, Roxb.

One sample was received from Kangra to be tested as an oil-seed. 100 seeds weighed 238·20 grams, 44·63 per cent. of which being kernels and 55·37 per cent. being shells. The kernels gave to ether 9·69 per cent. of oil. Thus this seed need not be considered as an oil-seed.

XXXIII.—*Schleichera trijuga*, Willd.

Eighteen specimens of this oil-seed were tested. Some samples had shells as well as the outer pericarp. Excepting these samples, the shells make 21 to 51 per cent. of the total seed and the kernels 49 to 79 per cent. The percentage of oil in kernels varies from 57 to 80. This oil contains small quantities of hydrocyanic acid probably generated by the action of an enzyme on a cyanogenetic glucoside in the seed. It has been tried for soap with success. It is reputed to have a very beneficial effect on the growth of hair. In the writer's opinion, this oil might form the base for all good hair-oils for which there seems to be a very large demand in this country. Spurious mineral oils are being used as bases for many country-made hair preparations and in the interests of the public, the manufacturers should turn their attention to the merits of this oil. It is reported that it forms the base of the well-known macassar oil.

No.	Locality whence received.	Weight of 100 seeds in grams.	Kernels per cent.	Shells per cent.	Oil in kernels per cent.	REMARKS.
1	Chhindwara, C P. ...	83·25	23·85	76·15	78·37	Shells and pericarps.
2	Sohagpur, C. P. ...	117·25	32·75	67·25	63·55	Do. do.
3	Do. (another sample.)	35·93	38·20	61·80	57·37	Do. do.
4	Do. (do.)...	53·40	55·40	44·60	68·12	This was received in form of kernels.
5	Betul, C. P. ...	...	...	...	68·06	
6	Rahatgaon ...	55·39	62·36	37·64	65·39	
7	Gorakhpore ...	88·60	49·24	50·76	79·55	
8	Kheri	35·84	55·70	44·30	64·44	
9	Damoh, C. P. ...	96·55	29·34	70·66	74·39	Shells and pericarps.
10	Pilibhit	47·47	54·44	45·56	62·71	
11	Gonda	87·98	35·40	64·60	78·51	Shells and pericarps.
12	Kumaon	48·90	48·98	51·02	60·87	
13	Swego, Burma ...	67·35	71·68	28·32	66·92	
14	South Salem ...	78·43	28·63	71·37	58·40	Shells and pericarps.
15	Burma	75·02	72·88	27·12	66·94	
16	Mandalay ...	74·93	64·00	36·40	66·92	
17	Nagpore	60·48	68·59	31·41	64·88	
18	...	32·03	79·28	20·72	57·02	

XXXIV.—Semecarpus Anacardium, Linn. f.

Three samples of this oil-seed were tested with the following results :—

No.	Locality whence obtained.	Weight of 100 seeds in grams	Shells per cent.	Kernels per cent.	Oil in kernels per cent.	REMARKS.
1	Chhindwara, C. P. ...	194·7	83·11	16·89	44·67	
2	Sohagpur, C. P. ...	191·8	82·80	17·20	42·02	
3	Betul, C. P. ...	...	...	...	39·11	Received in the form of kernels.

XXXV.—Sterculia fœtida, Linn.

Only one sample was received from Toungoo Division, Burma. 100 seeds weighed 100 grams, of which 54·10 per cent. were kernels and 45·90 per cent. shells. The kernels gave 52·23% of oil.

XXXVI.—Tectona grandis, Linn. f.

Only one sample of this seed from Surat was received to be tested as an oil-seed. The whole seed gave only 1·57 per cent. of oil. This should not be considered as an oil-seed.

XXXVII.—Terminalia belerica, Roxb.

Three samples of the kernels of the Belerica myrabolams were tested :—

No.	Locality whence obtained.	Percentage of oil in kernels.
1	Akola	31·18
2	Betul, C. P.	36·10
3	Jubbulpore	45·33

XXXVIII.—Ventilago calyculata, Tulasne.

Only one sample was received from Sohagpore, C. P. The kernels gave 60·40 per cent. of oil. 100 seeds weighed 10·22 grams, of which 54 per cent. were kernels and 46 per cent. shells and coverings, etc.

EXTRACTS.

IMPRESSIONS OF FOREST ADMINISTRATION IN BRITISH INDIA.

In the fall of 1904, the writer made a three months' trip to study the methods of forest management in British India. The trip included a visit to the sal forests around Dehra Dun; to the spruce, fir, chir pine and oak forests of the Himalaya Mountains at elevations of from 5,000 to 10,000 feet; also a visit to the plantations around Lahore. During this trip the writer had the opportunity of discussing administrative problems with a number of officers. This much is given by way of introduction to point out why the writer has used the title "Impressions of Forest Administration in British India." On the other hand, the *Indian Forester* has been studiously read in the last five years and perhaps a correct idea of some of the main points in Indian forest administration has been gained.

The climatic conditions in India make forest administration very difficult for a white man. He must live in out-of-the-way places; he must wage a continual warfare with the climate, and in less favourable localities—as in certain parts of Burma—Forest Officers are in danger of fever or other tropical diseases. Consequently, the success of the administration is all the more remarkable. Starting as it did in a small way under the leadership of the late Sir Dietrich Brandis, it has reached its present efficiency in a period of less than 50 years. The success is largely due to the personnel. The pay is excellent, ranging roughly from 1,400 dollars for the green Assistant Conservator of Forests to 6,400 dollars for the experienced Conservator (District

Forester), and at the end of 25 years' service, an average pension of 2,500 dollars per annum may be expected. In the early days the officers were ordinarily trained in France or Germany, but now there is a well-established school at Oxford where officers receive the major part of their training, supplemented by tours and assignments in Continental forests. Of course the subordinate force is paid far less than the average labourer in this country—a fire-watcher receiving perhaps 2·50 dollars a month, *without expenses*—but one must make allowances for the unreliability of the native labourer and the necessity for close supervision in considering the net cost of labour. The ranger force is well trained at Dehra Dun, and allowing for the native temperament, they may be said to be an excellent body of men.

A practical business administration stands forth as the foremost achievement. A substantial net revenue can always be assured. In the business success of the forest administration, economy, as well as the development and exploitation of the natural resources, have played important parts. Possibly in some parts of India there has been serious over-cutting due to the keen desire to secure financial results. For instance, it has been stated that the sandalwood forests have been depleted in order to enrich the exchequer.

Perhaps the most delicate problem which the forest administration has had to face is how to deal with the natives. An amicable settlement of the grazing and forage problems has often required great diplomacy. Even in fire-protection the native must be carefully handled, since in case of a large fire the untrained coolie must often be relied upon. Even the effect of the restriction of wanton timber cutting on local sentiment must be weighed; in almost every forest there is the so-called "village forest" which apparently is mutilated and grazed at will.

Fire-protection in British India it seems to me has been successful. In the "protected forest" there are carefully planned fire-lines, supplemented by a corps of fire-watchers and fire-fighters. Especially dangerous meadows are periodically burned over and

natural water-courses are often improved to make broad fire breaks. In the chir pine forests in the mountains the fire-lines usually run along ridges and there are many arguments presented locally in favour of not entirely clearing the line, but maintaining a scattered pine forest upon it in order to reduce the cost of clearance. The lines are burned periodically ; first guide lines (their width equals height of grass plus or minus) are cut on each border of the main fire-break, then when the grass is sufficiently dry, the whole break is burned under close control. There are numerous instances, however, where fires have escaped while these lines are burned, owing to the blaze unexpectedly getting out of control.

The grazing problem is logically handled. It is felt that the stock must be provided for and that properly regulated it can be made to assist reproduction. For instance, before a reproduction cutting, heavy grazing may be allowed. Afterwards it may be totally excluded until the second crop is sufficiently established.

Natural reproduction has been and is being carefully studied, but there is room for the application of scientific experimental station methods, and if these had been applied years ago, many of the perplexing problems would now be solved instead of being a matter of controversy. For example, does burning in a teak forest improve reproduction ? If so, is this improvement sufficient to warrant burning the humus ? What is the total net gain or loss ? What methods of cutting promote the reproduction of deodar, chir pine, or sal ? These are some of the problems which have been solved but in regard to which there is still some doubt. Reviews of the annual administrative reports bring out the lack of artificial reforestation. It is believed that a larger area should be annually artificially reforested that is now being done. At present there is practically but little planting or sowing done in India, considering the total acreage under forests.

Working-plans have been prepared for a comparatively small area. The main objection to these plans has been that they have not been made by the men most capable of making them, and they have not always been entirely practicable and workable. In

regulating the yield the natural loss through suppression or other causes has never been studied with sufficient care; this is an uncertain factor which I believe some day may lead to local over-cutting. Judging by our standards the growth figures upon which many of the cutting plans are based have been insufficient to warrant the inferences drawn. Nor have the volume tables been sufficiently accurate, although the yield has ordinarily been based on area and number of trees rather than the cubic foot—a detail which has made the working-plans more practicable.

While the education of the ranger force at Dehra Dun, for example, has been greatly perfected, yet there is need for an increase in the number of forest schools in order to secure a locally educated ranger force familiar with the problems with which it must deal. As compared with the United States the publicity movement, which is, of course, of great educational value, has not been pushed with the same vigor. Exceedingly interesting and valuable reports are often limited to small issues, so that the general public cannot be supplied. Possibly, this has been necessitated by the spirit of economy, and yet this seems to me to be a shortcoming.

Prior to 1906 the experimental work was carried on by a few enthusiasts who were subject to transfer at any time; consequently much of the value of these experiments was lost. In 1906 a Research Bureau was established which is now turning out excellent scientific work. Possibly this Bureau will be strengthened if it tackles the more practical every-day management problems that the officers in charge must meet, instead of conducting its work along such purely scientific lines.

It is well to emphasise, in conclusion, that the foregoing notes are merely impressions and are not based upon a complete study of Indian forest literature, such as is available ; nor upon an extensive tour in India. Yet one can say with a fair degree of accuracy that the Indian administration is to be praised for its net receipts, for its splendid supervisory personnel, for its efficient fire-protection, and for its understanding of the native problem. On the other hand, it is equally true that in future years there is room

for more aggressive artificial reforestation, for working-plans over a larger percentage of the area under merchantable forests, for accumulating a more extensive Indian forest literature of a high technical value, and for wider scientific research along practical administrative lines.

THEODORE S. WOOLSEY, JR.,
(in *Forestry Quarterly*, X, p. 626).

NOTE.—Since reading an account of the proposed change from the selection to the shelter wood system in the Teak forests of Burma on the recommendation of a member of the Research Staff, it appears to me the investigating officers are already tackling practical problems of management.—T. S. W., Jr.

DISCOVERY OF A SUNKEN FOREST.

The storms and heavy seas which have recently swept over the Pembrokeshire coast have been responsible for a peculiar happening at Freshwater West near Pembroke. For some little time the huge stretch of sand at this particular bay has given evidences of being washed gradually away in places by the action of the heavy ground swells, but on Friday last week, after a rough night, a most astonishing sight met the gaze of those familiar with the place. Half-way down the sands, between the burrows and the sea, a "sunken forest" covering a quarter of an acre was laid bare. Embedded in the black sandstone disclosed to view are the trunks of many huge trees, notwithstanding the lapse of time, in a splendid state of preservation. Most of the trunks are encrusted with sandstone, and it is, doubtless, due to this that they are so wonderfully well preserved.

Among the remains of the trees and the sandstone Mr. Dixon, of the Geological Survey, discovered a huge bone, a portion of the anatomy of some great mammal of prehistoric times, in a fair state of preservation. This bone is 4ft. long and nearly 18in. wide, and has been chipped in places, probably by the friction of countless stones upon it.

Photographs of the "sunken forest" appeared in the *Western Mail* of March 22nd.—[*Timber Trades Journal.*]

VARIOUS USES OF THE VEGETABLE OIL OF THE SEEDS OF THE RUBBER PLANT.

The vegetable oil used in making paper umbrellas in Japan is pressed out of the seeds of the rubber plant. This oil is made in the various islands famous for oil and seeds from these plants. Sandy ground is favoured for the cultivation of the plant and the oil is extracted from the seeds by presses. The yield of seeds is estimated at twenty bushels per acre. The annual production throughout Japan amounts to 350,000 bushels, from which over a gallon of oil per bushel is extracted. The oil before it is used is

boiled and then cooled until it can be applied by hand to umbrellas with a piece of cloth or waste. No machinery or tools are used in applying the oil. When the oiling is completed the umbrellas are exposed in the sun for about five hours. This oil is also used in making the Japanese lanterns, artificial leather, printing ink, lacquer, varnishes, oil paper, and paints.—[*Indian Trades Journal.*]

FORESTS IN BRITISH COLUMBIA, A HIGHLY PAYING CONCERN.

Forests in British Columbia have produced enough money in seven years to pay for all roads, wharves and bridges constructed in that period. The forest is only being cut one-quarter as fast as it is growing, and without detriment to the woods there can be produced lumber worth £20,000,000 annually.—Minister of Interior at Ottawa.—[*Timber Trades Journal.*]

ARTIFICIAL WOOD.

Many a large building in Germany is floored with a material, which is obviously not cement, because it is not hard enough, nor linoleum, because it is not quite soft enough despite its elasticity. Ask an architect what that curious material is, and you will be told that it is pressed sawdust mixed with magnesium chloride. Wood is too expensive in Germany to be burnt under a boiler—the American method of utilising most sawmill waste. Hence the sawdust floor. We, in the United States, have not been blind, says the *Scientific American*, to this new use of what was once a waste ; for the German manufacturer will tell you that the American, too, is beginning to mix his sawdust with magnesium chloride Like most German industries, however small, the process of making a flooring from sawdust is conducted on strictly scientific principles. Something more than a hap-hazard mixture of sawdust and magnesium chloride is required. The chloride absorbs water

very readily. It is what the chemist calls hygroscopic. Unless some scientific method is adopted to effect the mixture, a perpetually damp floor will be the result. Accordingly, the manufacturers have employed chemists to solve that problem for them. It is the business of the chemist to ascertain the correct proportions of the mixture. The usual process is to add the sawdust in the right quantity to a cement-like mass, composed of a solution of magnesium chloride, to which powdered magnesia is added. Sometimes the manufacturer delivers tiles of this composition, and sometimes he mixes the composition on the spot, works it in the form of a plastic mass, and allows it to set. The effect of linoleum and parquet flooring is obtained by adding colouring matter. Even wainscottings, stair coverings, and roofing tiles are thus made. One manufacturer supplies the raw material itself and the formula for mixing it, so that you can lay your own floor, and exercise your own ingenuity and good taste.—[*Indian Textile Journal.*]

CELLULOSE IN INDIA.

BY W. RAITT, F.C.S., CELLULOSE EXPERT ATTACHED TO THE FOREST RESEARCH INSTITUTE, DEHRA DUN.

Read before the Forest Conference at Dehra Dun, 29th March 1913.

It is not necessary for me to recapitulate at any length the arguments which have been set forth in great profusion during recent years to show the pressing necessity of discovering and exploiting new sources of paper-making material. My purpose is rather to indicate the capacity of India to supply some part at least of the new and enlarged demand. It will suffice to refresh our memories by a brief mention of the more important facts which have been adduced.

The world's consumption of paper is now estimated at about 9,000,000 tons per annum and its normal growth, leaving out of account the rapid abnormal expansion which results when a hitherto illiterate people begin to acquire education, is about 25 per cent. in ten years. Therefore, under normal development, in 1923 it will amount to 11¼ millions and in 1933 to 14 millions of tons. Of the present consumption about 80 per cent., or say 7 to 7½ millions, is manufactured from coniferous wood, chiefly Spruce and Fir. This enormous development of the wood-pulp industry has almost wholly taken place within the last 30 years. Its growth has been so phenomenally rapid and its inroads into the forests of

Scandinavia and North America have been so great that such expressions as "unlimited forest resources" and "inexhaustible supplies," with which its pioneers sharpened their axes, have long since been abandoned, and it has for many years now been recognised that this, conjoined with the demand for timber purposes, is much beyond the utmost possible sustained yield of the producing areas. Further, the cheapness of the product in the earlier years of its history was largely due to geographical reasons which, for similar reasons, have also disappeared. Wood-pulp factories were naturally erected in positions where forest and sea met, or nearly so, in order to secure cheap transport inwards of the raw material and outwards of the manufactured product. But such advantages are now gone for ever. Year by year, as the forests have been cut back from their original base, the cost of transport has advanced until it has reached a point which has compelled in many instances the abandonment of the mills. This is a factor which will have to be increasingly taken into account in the future, for while it is true that in the remoter regions of Canada Alaska and Siberia, there still exist vast and untouched resources, yet they are almost in another world as regards their distance from markets. The best proofs we can have that wood-pulp has ceased to occupy the position of a sufficient and almost sole supply are to be found, 1st, in the check to its growth, which, during its years of expansion was at the rate of 25 per cent. to 100 per cent. per annum, but which is now almost stationary, and, 2nd, in the gradual advance in price dating from the period at which rapid expansion ceased—qualities which were selling at £8 per ton five years ago being now worth £9-10-0. If this is the position now with an annual paper consumption of 9 million tons, it does not require a very long telescope to foresee what it will be ten years hence when the requirements are 11¼ millions.

There is another consideration which has an important bearing on the question. Paper is neither a necessity nor a luxury, it occupies an intermediate position best described as a convenience. For necessities we are prepared to pay a considerable advance on normal prices rather than go without. So also, on a more limited

scale, for luxuries. But for mere conveniences we will not, we merely contract our wastefulness. Paper, like mustard, earns its profits not from what we use but from what we waste and the waste paper basket is the paper-makers' best friend. Every man, woman, child and infant in arms in the United Kingdom uses and wastes, chiefly wastes, 50 lbs. weight of paper per annum. Consider what would occur if, to take one item only, newspapers were compelled to double their prices. The halfpenny paper would at once become extinct and the 20 millions who buy penny ones would at once contract to ten, the other ten would borrow from their neighbours. The moral of this is that paper, to maintain its position, has a strictly limited range of price; it must always be cheap enough to waste. Newspaper proprietors tell us that the upward limit has already been almost reached. Paper-makers are still more emphatically proclaiming that pulp *has* reached it. We have thus arrived at a position regarding wood-pulp at which no further expansion, on a scale in keeping with the growing requirements of the industry, is possible except at an increase of cost, and that cost has already almost reached its limits.

There have been pessimists who take so gloomy a view of the situation as to prophesy a paper famine. I can, however, see no grounds for so serious an outlook. The waste places of the earth are crammed full of cellulose waiting patiently for the exploiter to come along and the inducements for him to make his appearance are now sufficiently good to have caused both Governments and individuals to enter the field in no mean force. It is satisfactory to be able to claim that the Government of India has not been backward in taking its share in the investigations which are being carried on.

These investigations have proceeded along four main lines of enquiry. The first is the scientific management of Spruce and Fir forests with a view to the production of pulp-wood as distinct from timber. The second has concerned itself with the utilisation of woods other than coniferæ, but of little or no value as timber. The third is the production of crop plants, *i.e.*, the cultivation of annual or biennial fibrous plants specially for the paper-maker's use,

while the fourth has been devoted to the discovery and utilisation of nature's crop plants as distinct from her 30 to 60 year-growths, and which she at present throws into her waste basket and dust heap. Regarding the first it is not necessary for me to say much to a professional audience more familiar with what is being done than I can be. Permit me, however, to express very grave doubts as to whether a permanent and complete solution of the problem will ever be found in growing a timber producing tree specially for pulp-wood. All such efforts must inevitably resolve themselves in the end into growing for the higher value obtainable as timber. Consequently only the thinnings will be available for pulp-wood and these will only be obtainable during a limited portion of the life of the plantation—say 30 years out of 90. And they will be useful to the pulp-maker only if they remain at their present value. But every advance in timber values automatically advances the price of the smaller logs. Uses are every day being found for them in directions for which only the large logs were used a few years ago and the whole trend of the timber-using industries is to snatch the small trees out of the pulp-maker's grasp. Bear in mind that the question at issue is not merely whether the present output of wood-pulp can be maintained—possibly it can—but that aspect of the matter is altogether overshadowed by the larger question whether its present 7 million tons annually can be increased to 10 millions within ten years and 12 millions within twenty.

The second line of enquiry, *viz.*, the utilisation of species other than coniferæ and not good enough for timber, is one to which we have contributed something in this country but I am free to confess that it has resulted in disappointment. The cellulose is there, and in most cases in sufficient quantity but of poor quality and of a value rarely sufficient to repay the cost of manufacture. Here again also, we come up against the difficulty of securing a sustained yield within the economic transport radius of a factory. The trees take say 30 years to grow to a sufficient size, natural reproduction is uncertain and any attempt at artificially helping it raises the cost. Further the land on which they

grow (I am alluding to soft-wooded deciduous species of which *Bombax malabaricum* and *Boswellia serrata* are types) is already partially stocked with another class of pulp-yielders to which I will allude presently, the growth of which it is preferable to encourage even at the expense of these and similar inferior trees.

The third line of enquiry, *viz.*, the artificial cultivation specially for paper-making, of fibrous plants yielding annual or biennial crops is also one in which ultimate success is extremely doubtful. It brings us up against the full force of the historical argument. Paper-making has never yet been able to subsist upon anything which has cost money to produce. It demands either the fibrous waste of mankind, that is rag and the rejections of textile factories, or the waste of nature. To superimpose the cost of cultivation either raises the value beyond the paper-maker's reach or, what amounts to the same thing, the grower quickly realises that the time and money he has spent would have been more profitably employed in producing one of the three f's of Agriculture, food, fodder or fibre, (*i.e.*, textile fibre). The law holds good with every variety of material and has never yet been broken. The Esparto grass of the Mediterranean regions costs nothing to produce, the cereal straws only enter the paper-maker's kingdom in countries where it is not in serious demand for fodder. Even Spruce now finds itself under its operation. It is, or was, a paper-making material only so long as it is, or was, one of nature's waste products for which no other use could be found.

We are therefore driven back upon the last line of research enumerated above in order to get a full and satisfactory solution of the problem. We must go to nature's storehouse and take that which she offers us as a free gift because no one but the paper-maker wants it or can make any use of it. The waste places of the earth and especially of the tropics and sub-tropics team with suitable fibrous plants yielding their crops in due season, annually, biennally or in 3, 4, or at most 5-year periods. With these, nature herself solves the sustained yield problem and there is no need to tap her 30, 40 or 60 year growths with which reproduction is uncertain and a sustained yield a difficulty. The Government

of India has therefore wisely confined its efforts chiefly to this phase of the question. These have already met with a fair measure of success and I am only prophesying what we know in looking forward to a time, not far distant, when India will claim her place as one of the important cellulose producing countries of the world.

Let us examine somewhat minutely India's claims to such a position. The class of plants we are now to deal with are certain species of *Gramineæ*, comparatively few in number but amounting in the aggregate to an enormous and incalculable total, owing to their wide distribution, their rapid growth and their almost unkillable natural reproductive powers. The essential requirements of the pulp industry are (1) a sustained yield of raw material within a somewhat narrow radius of a factory, (2) manufacturing facilities in the shape of water, labour, fuel and lime, (3) transport for the manufactured product by rail or water and (4) a settled Government with the security it affords for life and property. Summed up, these mean a somewhat unique approximation of the primeval wilderness and the resources of civilisation. Nowhere in the world do these two primary conditions meet and interlace to the extent they do in this country. No doubt there are elsewhere huge tracts producing suitable material. Possibly, but doubtfully, water, fuel and lime are to be found in conjunction with the raw material. Possibly also, but still more doubtfully, labour may exist, but transport is almost wholly absent and governmental rule is more honoured in the breach than the observance. India has them all in rich profusion. Then her geographical position counts for something. She is midway between the West and the extreme East. This means much when we consider that the great forward movements of the future in paper consumption must take place among the large populations now awakening from the intellectual sleep of centuries. In Europe the industry may be expected to pursue steadily its normal advance of 25 per cent. in ten years, but in China and Japan the advance, during the last ten years, has been more like 250 per cent. and the present consumption is almost wholly supplied by European wood-pulp to the

amount of 80,000 tons per annum. What more likely than that this trade will be diverted to India as soon as she is in a position to undertake it. Our geographical position serves us equally well as regards Australia which can never be a paper-manufacturing country. Her supplies now come from Europe and North America and will assuredly be drawn from India at no distant date. Finally consider our own domestic demand. It amounts now to about 70,000 tons per annum of which about 45,000 tons is imported as paper and about 10,000 tons as pulp, for it is one of the extraordinary anomalies of the situation, and one which we hope very shortly to abolish, that the small amount of her own requirements which India does manufacture can only be accomplished by the aid of European pulp to this extent. There is, therefore, over and above the present manufacture from indigenous materials, a market of 55,000 tons per annum to be supplied within our own borders and this is a market which, like that of the Farther East, is growing much more rapidly than the normal growth of the more highly educated communities. It is twice what it was twenty years ago but it still only amounts to one-third of a pound weight per head per annum. Contrasted with the 50 lbs. per head of England there seems to be a good deal of leeway still to make up but every forward movement in education is helping it on.

A few words may now be permitted to recount what the Government, through its Forestry and Research Officers, has already accomplished in the preliminary work of laying the foundations of the structure which is to meet this demand. Our work has, as I have already mentioned, been chiefly devoted to investigating the possibilities of a limited number of *Gramineæ*. With bamboo, we have lately, under Mr. Mercer's supervision, been able to surmount the difficulties of manufacture which for 30 years have delayed its recognition as a suitable material. Had these stumbling blocks been capable of being climbed over when Routledge first introduced it to the notice of paper-makers, I doubt very much whether wood-pulp would ever have obtained its present commanding place. However, they are now gone and the coping

stone has been put on the edifice by Mr. Pearson's recent monograph* on the Economics of the subject, a publication containing solid and enduring information which will be just as valuable 50 years hence as it is to-day. The other branch of our *Gramineæ* enquiry has concerned itself with the coarse Savanna grasses. The botanical side of this has already had much attention from Mr. Hole and his work is still proceeding. On the practical side the premier place belongs to Mr. Clutterbuck who was the first to demonstrate their usefulness in his laboratory at the Allahabad Exhibition. The work he instituted has since been continued here by Mr. Mercer and the results are now in the press. We have found that at least eight of the most widely distributed species produce, at an economical cost, pulp of an exceptionally high quality possessing in a high degree those virtues of toughness and endurance which have hitherto been considered the monopoly of fine linen and cotton rag. The net result of these investigations of bamboo and Savannah grasses has been to add many thousands of square miles and millions of tons to our available cellulose resources.

One other subject has received some attention, *viz.*, the utilisation of our Himalayan Spruce and Silver Fir. The species existant are almost exactly similar to their European congeners and produce pulps of similar quality. The chief difficulty is their remoteness from suitable manufacturing localities, but it does not seem impossible that this may be surmounted by floatation of the logs from the forests to factories in the plains. Where these can be built on water-powers, it appears to be quite feasible to convert the wood into that cheapest form of pulp known as mechanical or ground wood-pulp. This is the material which supplies the element of extreme cheapness in the lower grades of paper used by newspapers, and largely imported into India for the common bazar trade. I refer to this branch of our enquiry chiefly for the purpose of pointing out the unique position India holds in possessing within her borders, not only vast stores of raw material, but in having

* Note on the Utilization of Bamboo for the Manufacture of Paper-pulp. by R. S. Pearson (*Indian Forest Records*, Vol. IV, Part V.)

them existant in forms capable of being rapidly converted into the three qualities of pulp most in demand : grass for superior grades, bamboo for secondary and mechanical wood-pulp for inferior. Cheapness, irrespective of quality, is such an important consideration in India that the position would be incomplete without some provision being made for it. Mechanical wood-pulp fills the bill completely and with its inclusion in the list India's house is full and her boundaries perfectly rounded off.

It may now be asked whether these investigations and discoveries are to add to or detract from the many details of forest management which now compass the harassed Conservator. As regards Spruce and Fir, it is unlikely that any serious questions of re-afforestation such as have occurred in Europe will arise. Your areas are virgin and when you commence to tap them you will, of course, do so under a system which will ensure a perpetual sustained yield. The one important point which you may have to decide is whether a Spruce and Fir area can be regarded as a wood-pulp area. This will have to be settled solely by reference to the manufacturing facilities and, in the case of mechanical pulp, these are water-power and a railway. You have to bring wood, power and rail to a common meeting point. If you cannot do this, then it is not a wood-pulp area. In regard to bamboo and grasses, enough has been done to give a new and a very much contracted meaning to the term unproductive area. It frequently, I believe, falls to your lot to decide whether an unproductive area should be afforested with valuable timber and you have hitherto rightly assumed that all coarse grass and most bamboo areas are unproductive. In future you will not be able to do so. An area *now* is not unproductive because it is covered with grass or bamboo but only if it does not contain the necessary facilities for manufacturing these into pulp, and as each manufacturing site can work up all the material within a radius of 20 miles (where river transport exists this may be largely extended) you must necessarily divide up the area into blocks of roughly 40 miles square and consider each upon its merits with sole regard to manufacturing facilities. If these exist, then the

area is not an unproductive one unless you can show that a better profit can be made by afforesting it. It is too early yet to say with any authority what such pulp-producing areas will be worth, but from all that we do know now, I hazard the opinion that an area fully stocked with bamboo or suitable coarse grasses, and possessing manufacturing facilities, will be found to be worth not less than Rs. 2 and possibly Rs. 3 per acre per annum in royalties. If you can make more than this by afforesting it then the pulp-maker must stand aside.

In all that I have said hitherto I have dealt with pulp solely from the paper-making point of view, but this is, after all, only one of its many applications though, as yet, it is the largest. The term pulp is itself a constrictive and limited one. We had much better use the more comprehensive as well as more scientific one of cellulose. The uses to which cellulose is now being put, apart from paper-making, are so numerous and increasing so rapidly that their mere enumeration would be bewildering and fill several pages of my paper. They range from railway-carriage wheels to neckties, from gaspipes to hair-combs, from armour plate backing to milk-bottles, from high explosives to babies' rattles, from electric insulators to kinematograph films. With such vistas of usefulness, we need not enlarge on the commanding commercial position which the future contains for countries owning large resources of the raw material in conjunction with manufacturing facilities. Nor need we wonder at its approaching universality in the arts when we remember what nature has done with it in her laboratory. Cellulose is the basis of all forestry and agriculture, the foundation of all our textile industries. Coal, upon which three-fourths of our industrial activity depends, is simply petrified cellulose. Nature has used it as a universal framework upon which she has built up nearly all her organic activities. What she has done with it, man is learning to do day by day. This marvellous substance, apparently so unmanageable, so inert, so dead, has under the hand and brain of the inventor, proved so plastic, so malleable, so convertible, that the prophecy of a cellulose age, no unworthy successor of the iron, bronze and stone eras which have preceded it, is every day

becoming more of a reality and less of a dream. On your next homeward voyage you may go on board your steamer in a cellulose suit with a cellulose hat and cellulose boots. You may dine in a cellulose-panelled saloon floored with cellulose mosaics at a cellulose table on a cellulose chair. You may eat with cellulose-plated teeth and cellulose-handled knives and forks off a cellulose plate laid on a cellulose cloth and flanked with a cellulose napkin. You may drink cellulose whisky from a cellulose tumbler and coffee sweetened with cellulose sugar out of a cellulose cup. Should those familiar elements, air and water, be unruly unfortunately they are *not* cellulose and are therefore unmanageable, and call you to the seclusion which the cabin grants, you may rest your spasm racked frame on a cellulose couch behind a cellulose curtain. Your faint and woeful cry of 'Steward' will produce a minion armed with a cellulose basin. Should your sufferings be so great that you are called upon to render up the last debt of nature, you will write your will upon cellulose parchment and console yourself with the thought that your classic features will be preserved for an admiring posterity in a cellulose bust. You may then hasten your escape from torture with a dose of cellulose oxalic acid and your remains will be committed to the deep in a cellulose coffin covered with a cellulose flag, and it is not at all certain that you won't be ferried across the Styx in a cellulose boat.

I hold in my hand a specimen of one of the most recent transformations of this wonderful medium. In the form in which I present it to you it is intended as a cheap substitute for jute sacking, but its great significance is that it is a spun and woven fabric. Hitherto paper has been considered, in comparison with textiles, so deficient in tensile strength and bursting strain that it has been denied a place in the textile family and relegated to the position of scavenger and Cinderella of the proud sisterhood. Now, it takes its place among them as one of themselves. It does not require a strong imagination to see unlimited lines of advance now that it has been proved that it can be both spun and woven. You are aware that the world has outgrown its supply of textile fibres,

that the cotton industry is making huge efforts to enlarge the producing area and that jute manufacturers are now paying prices for their raw material which would have been scouted as impossible ten years ago. It would not surprise me greatly if one line of relief was afforded by the new development of cellulose which this specimen illustrates and to see Cinderella once again come to the assistance of her prouder sisters. The paper suit of clothes has been, before now, a subject of demonstration both ocular and jocular—chiefly the latter—but that was with paper in the familiar sheet form, with its low tensile and bursting strain. One shudders to think of the position which might be created by suddenly bending down in a paper pair of trousers to pick up a tennis ball at a Forest Conference garden party, but I would not hesitate to risk my own dignity in a suit built of such material as this—I would even undertake to guarantee the dignity of a Member of Council. In future you will buy your summer suits by the gross instead of by the dozen, and at a price for the gross not greatly in excess of what you now pay for the dozen. When a suit is soiled beyond further wear you will simply put it on the fire or sell it to your bearer for half price. Think of the saving in dhobie hire alone!—and thus does science once again come to the aid of the harassed official who so good-naturedly persists in serving an ungrateful Government for a miserable pittance.

PROSOPIS JULIFLORA, *DC.*

Having read Mr. Hole's article on *Prosopis juliflora* in the *Indian Forest Records* * it occurs to me that the following notes on this tree in the Punjab may be of interest. One striking peculiarity about the plant is that wherever large specimens are seen in dry and arid districts, natural seedlings are almost sure to be found in abundance in the immediate neighbourhood. The tendency of *P. juliflora* to spread naturally may be seen on the unirrigated strip of land between the canal and the plantation at Chānga-Manga. Here the rainfall averages 15 inches and the

* *Indian Forest Records*, Vol. IV, Part III, 1913.

PROSOPIS JULIFLORA, DC.

Fig. 1. A tree 4′ 8″ in girth in the Govt. Agri-Horticultural Gardens, Lahore.

Photo.-Mechl. Dept., Thomason College, Roorkee.

Fig. 2. A natural Seedling in the Canal Bank at Changa-Manga, Punjab.

strip of land referred to carries a sparse growth of the trees which were found in this district before the plantation was made, *i.e.*, *Prosopis spicigera, Capparis aphylla* and *Salvadora oleoides*. A few trees of *P. juliflora* were planted some years ago in this strip and they are spreading rapidly, the seedlings being in places so dense that it is difficult to walk through them. Cattle graze here daily but plants within easy reach show no signs of having been browsed. Seedlings of the indigenous trees it may be remarked are conspicuous by their absence. *P. juliflora* keeps to the unirrigated ground and shows no inclination to spread into the plantation.

In Khushalgarh in what once was the compound of a P.W.D. building but which now is the most accessible portion of the village grazing ground, there are two *P. juliflora* trees about 2 ft. in girth and 25 ft. high. A few root-suckers of *Capparis aphylla* badly browsed by goats and a soft sandstone rock describes the growing stock and soil of the surrounding waste. The rainfall is, I believe, about 18 inches. In spite of these unfavourable conditions seedlings of *P. juliflora* are plentiful around the large trees and extend some distance away into the village waste.

In the Pabbi reserve *P. juliflora* has been successfully used in reboisement works and has made considerably faster growth than *Acacia modesta* with which it has as a rule been mixed. Regeneration of *P. juliflora* is frequent in the Pabbi reboisement area whereas natural seedlings of the indigenous trees are difficult to find. *P. juliflora* was tried many years ago at Gujranwala. I have not seen the original trees but along the railway line all the way from Gujranwala to the Pabbi Hills natural seedlings of *P. juliflora* may be seen at frequent intervals. *P. juliflora* has certainly come to stay in the Punjab and it is likely to be a common tree in all the drier districts in time.

I have grown *P. juliflora* on a small scale almost every year since 1906 mainly without much success, but as failures often teach us more than success, I mention some of them. In 1906-07 I tried *P. juliflora* at Nurpur, district Kangra. The plants grew well as long as they were in pots, but on being planted out they

did badly and none were left when I visited Nurpur in October 1912. In Nurpur the rainfall is 67 inches but the plants were tried in a dry well drained place. In the winter of 1907-08 I planted some plants in a hedge of Agaves at Phillaur. The plants were not watered at all but I saw them on the 30th June 1908 (the rains broke next day) and found them all doing well. I looked for these plants when I next visited Phillaur in July 1912 but found very few left and these had made poor growth. A few hundred yards off there was a natural seedling of *P. juliflora* growing in a field and the growth made by this plant in the four years 1908—12 was very marked. The rainfall in Phillaur is about 30 inches. In 1909 I tried *P. juliflora* in a grassy blank in one of the scrub forests in Hazara. I saw the sowings about a year later and found that the plants had made very poor growth and gave little promise of surviving. In this case the rainfall was 30—40 inches.

The spread of *P. juliflora* over grass-lands in parts of America has been attributed to the stocking of the country with cattle which graze down the grass and weaken it and thus enable the tree to compete successfully against it. In the cases of failure with *P. juliflora* mentioned above there was a fairly heavy grass growth and protection from grazing and it seems that this may have been responsible for the bad results. The rainfall could not have been responsible except perhaps indirectly by favoring the growth of other plants, as the natural seedling in Phillaur showed. This seedling was in a place where grass and jungle were kept down by cattle. Cattle and even goats seem to do little harm to *P. juliflora* and I have often been surprised to see the leaves untouched, although within easy reach of cattle and at a time when there is little green fodder available.

As regards frost-hardiness, I have seen seedlings pass through a winter at Abbottabad (4,000 ft.) uninjured, so that it may be regarded as quite hardy anywhere in the plains of India.

The habit of *P. juliflora* is peculiar, most of the trees and all the natural seedlings I have seen branch at ground level giving several crooked branches as shown in the illustration of a natural

seedling at Changa-Manga (see Plate 7). There is however an erect form and the two big specimens in Khushalgarh had an upright habit not unlike that of *Acacia arabica.* This form however is not constant as the seedlings from the Khushalgarh trees all showed the usual crooked habit.

As regards the rate of growth of *P. juliflora,* G. B. Sudworth says in "Forest Trees of the Pacific Slope.": "The tree is unquestionably long lived though of exceedingly slow growth. Trunks 10—12 inches in diameter are from 100 to 125 years old, while the larger trunks occasionally found are likely to be very much older." This does not apply to the tree in India as it has only been introduced some 35 years and specimens 6–8 inches in diameter are not infrequent, and the tree shown in the illustration which is probably the biggest in the Punjab is 4 ft. 8 in. girth. This tree is growing in the Government Agri-Horticultural Gardens, Lahore, and has of course received constant irrigation. This specimen, although it has a single stem, does not give a very good idea of the erect habit seen in some individuals.

As a drought-resister I know of no tree to equal *P. juliflora.* It has been used with success to clothe some old brick-kiln mounds in the Government Agri-Horticultural Gardens, Lahore. The average rainfall in Lahore is 19 inches and of this a large portion usually falls in heavy showers on one or two days in the year and runs off the steep slopes of the mounds so that the trees have to manage with considerably less than 19 inches of effective rain. Two years in succession of deficient rain has caused some of the plants on the top of the mounds to lose the tips of their shoots, but although there must be fully 100 specimens I have not seen a single one that has died of drought. On the very top of one of these mounds a sowing was made in 1911. The seedlings were not watered and the rainfall in 1911 and 1912 was 13 and 14 inches respectively. When I last saw the place about a month ago a good many plants were left. The place is much frequented and the survivors all showed signs of having been trodden on so that it is quite likely that those which died, died from having been trodden on and not from deficient moisture. Mr. Brown,

Superintendent of Farms, N.-W. F. Province, tells me he has *P. iuliflora* growing luxuriantly on the crest of a dry bank near Peshawar. The plants were planted in February 1911 and were not watered, the rainfall in 1911 amounted to 13 inches and to 8 inches in 1912. The ability of this plant to withstand drought is astonishing, especially as it comes into leaf early in April and remains green right through the hot weather.

In para. 4 Mr. Hole calls attention to the liability of exotic plants to injury from diseases and insects which is of course true, particularly in the case of plants brought into a climate different to that to which they are accustomed in their native habitats. There is however another side to this question. Anyone who has collected seeds of Indian Acacias or Albizzias, must have noticed the large proportion attacked by insects. With *Acacia modesta* in the Punjab it is not uncommon to find fully half the seed crop destroyed by weevils. In the case of *P. juliflora* seed collected in India I have never seen a single seed attacked. To this is perhaps largely due the profuse reproduction of *P. juliflora* in suitable localities as compared with the indigenous trees. During the past 18 months I have received several consignments of *P. juliflora* seed from Mexico and in each case found a very large proportion of the seed destroyed by weevils.* It is evident that *P. juliflora* on being brought to India has left its natural enemies behind. The publicity given to the merits of this tree may perhaps lead to fresh consignments of seed being imported from America, and if this is done care should be taken to see that the weevils are not introduced too. As seed is produced in abundance in India there is no need to import it from America unless the object be to obtain other varieties than var. *glandulosa*. Last year over 60 maunds of seed was collected in the Pabbi Reserve and several maunds could be collected annually in Lahore or Changa-Manga.

DEHRA DUN: R. N. PARKER, I.F.S.

12th May 1913.

* We hope it may be possible to send specimens of these to the Forest Zoologist for dentification. It will be most interesting to know whether they, or their near allies, are known to occur in the Indian region.—HON. ED.

A POSSIBLE SUBSTITUTE FOR SHELLAC.

The high prices which ruled the shellac market in 1906 and 1907 resulted in the appearance of several substitutes, none of which have, so far, been able to take the place of the real article to any very large extent.

Since this date, prices have gradually fallen to a normal level as is shown by the following table giving the London prices for "Fine Orange Shellac":—

Date.			Price per cwt. s. s.
21st February	1906	... ...	195—201
20th do.	1907	... ...	230—250
19th do.	1908	... ...	130—150
17th do.	1909	... ...	115—130
16th do.	1910	... ...	70—100
1st do.	1911	... ...	85—100
1st do.	1912	... ...	75—90
1st do.	1913	... ...	80—90

One of the substitutes experimented with at the Imperial Institute, London, and at the Forest Research Institute, Dehra Dun, was a resin—*Black Dammar*—obtained from *Canarium bengalense*, a tall evergreen tree found in Assam.

A sample of this resin was sent to the Imperial Institute, who handed it over to certain manufacturers of crape in England for experiment as to whether it could be used as a substitute for shellac in stiffening black crape.

The firm reported that, though the resin was the best substitute that they had so far found, it had the disadvantage of filling up the mesh of the fabric in the process of clearing by heat, due to the high melting point of the resin as compared with shellac.

To overcome this difficulty experiments were carried out in the laboratories of the Forest Research Institute and the following samples were sent to England prepared as follows :—

(*a*) Resin dissolved in petrol, distillation of the latter and subsequent driving off all traces by blowing air into the resin.

(*b*) Resin prepared in the same way as (*a*) and mixed with 8 per cent. bees-wax.

(*c*) Resin prepared in the same way as (*b*) but mixed with 16 per cent. bees-wax.

These samples were submitted for technical trials to the crape manufacturers referred to above who stated that samples (*a*) and (*c*) could not be used to replace shellac, as the resin did not clear sufficiently from the meshes of the fabric. Sample (*b*) proved most likely to be serviceable, as its clearing properties were superior to (*a*) and (*c*); and, though it was impossible to obtain as stiff a finish with this resin as with shellac, it might possibly be used where a soft finish only was necessary.

Its use in the manufacture of varnishes is not recommended as it leaves a heavy residue and is of poor quality compared with a *Dammar* which is exported from Singapore at about Rs. 48 per cwt. at Calcutta.

No accurate estimate of the yield of this resin has so far been made but the tree occurs scattered fairly evenly throughout the forests of the Sibsagar and Cachar Divisions of Assam. The yield per tree per annum is stated to be as much as 17 seers but apparently this is too high a figure on which to base any estimates and 6—8 seers would probably be more nearly correct. The resin can be purchased in the local bazars at about Rs. 25 per cwt.

Further experiments in tapping and enumerations are necessary in order to calculate the possible annual outturn which should be considerable.

It seems therefore that, though this resin can never be expected to compete with shellac in the principal trades in which it is used, it might be used in certain cases should the price of shellac again reach its former high limit.

E. BENSKIN, I.F.S.,
Assistant Conservator of Forests.

17th April 1913.

AN EXTRAORDINARY PHENOMENON IN A MAHOGANY (*SWIETENIA MAHAGONI*) SEEDLING.

On the 10th July 1912, some Mahogany seeds collected from trees introduced into and growing at Quilon in Travancore, were sown in a deal-wood box filled with sandy soil. The bulk of the seed germinated between the fourteenth and the sixteenth day after sowing. In the first week of August, the seedlings were pricked out into bamboo cylindrical baskets and kept in shade in the verandah of the Conservator's Office at Quilon. On the 2nd October, 50 basketed plants were sent to Trivandrum for distribution to the Public Gardens, Residency and other places. Some of the seedlings were planted in the Trivandrum Forest Depôt compound on the 10th *idem*. The soil in the locality is lateritic and well drained. When the writer inspected the seedlings on the 18th April 1913 he found one of the seedlings with two flowers on the plant close to the leading shoot and two flowers lying at the foot of the plant. He picked up three out of the four flowers and on examination with a lens found them to be complete with four sepals, four petals and anthers varying from 7 to 9 at the mouth of the staminal tube, and the pistil with the style and stigma complete. On comparing these flowers with those of mature trees some of which are in flower just now, the writer has found no difference whatever between them in size and shape. As he considers it extraordinary that a seedling barely *ten months* old should produce such normal and complete flowers, he brings it to the notice of the *Indian Forester*. The three flowers picked up are sent to the Editor* for being examined by a Specialist in Botany.

QUILON: M. RAMA RAO,
2nd May 1913. *Provincial Forest Service.*

[* The flowers in question have been sent to the Forest Botanist, Mr. R. N. Parker, who has kindly supplied the following note.—HON. ED.]

This is not the first record of *Swietenia Mahagoni*, Jacq., flowering as a seedling. In Hooker's *Icones Plantarum*, plate 2786, Mr. Hemsley describes *S. Mahagoni*, var. *præcociflora*, from material sent from the Royal Botanic Gardens, Trinidad. In this case the age of

the seedlings was not mentioned but it is stated they were 6—10 inches high. The flowers were abnormal in several respects, chiefly in the sepals equalling the petals, a campanulate staminal tube, the absence of a disc and a rudimentary ovary. I have examined the flowers sent by Rao Sahib Rama Rao and find them to be quite normal presenting none of the peculiarities of var. *præcociflora*, Hemsl. It would be interesting to watch the later development of this seedling to see if it dies or flowers again next year or grows on normally. A case of precocious flowering of *Dendrocalamus strictus* will be found in the *Indian Forester*, Vol. XXV, p. 22.

R. N. PARKER, I.F.S.,
Forest Botanist.

10*th May* 1913.

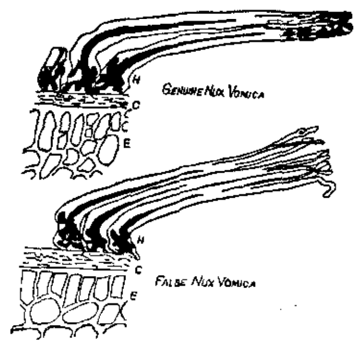
NOTE ON FALSE *NUX-VOMICA* SEED.*

BY JAMES SMALL, PHARMACEUTICAL CHEMIST.

A new kind of nux-vomica seed was recently sent over from Burrra and offered to manufacturers, but on examination it was found to contain no strychnine. The seed is of a light grey colour externally and yellow internally. The yellow endosperm is much

* Communicated to the Pharmaceutical Society Great Britain, at an Evening Meeting in London, on Tuesday, April 8th, 1913.

lighter in colour tha that of *Strychnos Nux-vomica*, which is usually dark grey and more translucent. The outer surface is densely covered with closely appressed hairs. The seed is flattened, round, or elliptical, and has a ridge around the edge where the two disc-shaped masses of endosperm meet. There is no trace of bitterness in the taste, which in itself is good proof of the total absence of strychnine.



RADIAL TRANSVERSE SECTIONS OF STRYCHNOS SEEDS.

Transverse radial sections of the seed were cut and examined. The three tissues present are the endosperm, the layer of collapsed parenchyma, and the hairs. The internal mass of endosperm is almost identical with that of *Strychnos Nux-vomica*. The outermost layer, E, shows a slight difference. In the genuine nux-vomica seed the cells of this layer have frequently more or less triangular ends, as seen in section, while in the false seed these cells are more usually square-ended. These cells vary somewhat and square ends occur rather too frequently in the genuine seed to permit of any diagnostic value being attached to this character. The layer of parenchyma, C, is the same in both seeds. The bases of the hairs, H, are practically identical, but the angle which the rest of the hair makes with the hair base is slightly larger in the false than in the genuine seed. The longitudinal, rod-like thickenings, which form the wall of the hair in each case, show a slight difference. In the genuine seed these thickened parts usually

remain coherent at the tip of the hair, but in the false they frequently separate and show a slight curvature at the extreme end. These insignificant differences, of course, are of no value in the examination of the powdered drug, and if the seed is entire it is easily distinguished by its lighter colour and the ridge round the edge, as well as the complete lack of any bitter taste. Since there is no significant difference in microscopic characters, a short series of experiments was made to try to find a chemical test whereby the false seed could be detected. Since it was required to distinguish the false seed, the positive tests for strychnine were, of course, valueless, since a mixed powder would give these reactions. Transverse sections were cut and examined under a simple lens and also under the microscope while being treated with various reagents. The reagents used included strong nitric acid, a mixture of strong nitric and sulphuric acids, 50 per cent. sulphuric acid, 50 per cent. sulphuric acid with potassium dichromate, potassium hydroxide solution, B. P. strong solution of iron perchloride, and solution of iodine and potassium iodide. No difference was observed in the reactions of the two seeds with these reagents.

As the published accounts of the genus *Strychnos* give very meagre details with regard to the seeds, it has not yet been possible to assign the false seed to its species, although its structural identity with that of *Strychnos Nux-vomica* leaves no doubt that it is a species of *Strychnos*.

In this work, also, I am much indebted to Mr. Holmes for the material and also for many suggestions.—[*Pharmaceutical Journal.*]

FORESTRY IN THE BRITISH ISLES.

It is well that the eyes of the British people have at last been opened to the folly of neglecting their own Home timber industry while depending almost wholly upon foreign produce for their requirements, and from time to time bewailing the growing scarcity of certain timbers with a steady rise in price. The same callousness has marked the Home agricultural industry because it

was possible to fill returning ships with grain that left the country laden with its manufactures. In fact it was fast coming to be understood that it was the destiny of England to devote its whole attention to manufacture, that it was to become the workshop of the world, while the world in return was to be its granary and likewise its timber depôt. This policy for many years brought vast wealth to the country ; but meanwhile other countries became large manufacturers too without losing sight of the necessity of remaining also their own grain and timber producers and are thus to-day in a sounder economic position. The fact has attracted attention and it is probable that measures will be taken to recover lost ground. As regards British forests, the nncleus of reform may be found in the Cambridge Forestry School which is now carefully studying the Forest methods of America with a view to inaugurate similar methods at Home. It seems a little strange that this should be so considering that the American Forest Department is itself a comparatively new one and learned some of its lessons from the Forest Department of India. Can it be that in 20 years the Forest Department of the United States has so far outstripped the working of the Indian Department as to be in a position to teach Forestry to the British student ? It would appear so, else why should the Cambridge School not have studied Indian systems instead of American. The position now is that there being no forests in the British Isles to speak of and in consequence no Forest Department organisation of consequence, students for the Indian Forest Service are sent to Germany to learn their practical business, then American organisation is grafted on Indian and lastly, the cycle is completed by British organisation seeking its lessons from America. Truly a remarkable network of instruction! But we need not quarrel with it if it brings about the desired result of a real re-afforested England, and a real English Forest Department run on scientific lines. At present there is very little knowledge of forestry at Home, such planting as is done is done empirically by owners of forest land, with the result that the timber produced is far from the best, since the proper soil, the proper aspect and the proper methods of culture have not been adopted.

Disappointing results with such timber have given the Home produce a bad name and opened the door to foreign importations. The engineers and architects of the country know practically nothing of these foreign timbers and are in consequence easily duped into accepting qualities that are not in accordance with what they have ordered. What is wanted, therefore, is a State Department that has at its command all the knowledge necessary for classifying timbers, for specifying the particular species that should be grown in the country, where they should be grown, and the method of culture. It is believed by those who have studied the subject that British timbers of many kinds are really superior to foreign ones that have supplanted them in the market, but that the haphazard way in which they have been grown and the market managed has created an impression of their inferiority. The Cambridge Forestry School is now about to do some research work, taking each British timber in turn, beginning with Scots pine, and studying its properties to show how it stands in relation to imported timber that is preferred to it. When this is done and a proper knowledge diffused as to the species of woods which it would pay to cultivate in the British Isles it is believed a strong stimulus will be given to forestry, and owners of forest land will respond by stocking their property with the right kind of timber, and on scientific lines. This is only a beginning, but it is hoped there will be a considerable extension of the work being undertaken by the Cambridge Forest School, and that the State will take a more direct part in re-afforesting the country and in managing the forests on proper principles.—[*Indian Planter's Gazette.*]

SEASONING TIMBER.

A very simple method of seasoning timber, given by a French contemporary, consists in saturating it with linseed or other drying oil and exposing it for a sufficient time to moderate heat, says the " Builder." After cooling the timber is found to be smooth, glossy and hard. It is also stated that by removing the bark when the sap is in full flow, some months before

trees are felled, the strength of the timber is augmented by about 15 per cent. Another method of treating timber is to strip the trunk down to the sapwood immediately the tree has been felled cutting it into planks, soaking these for six days in lime-water, and afterwards drying in the open air, sheltered from the sun. Timber seasoned in this manner is said to suffer far less from the effects of atmospheric conditions than timber dealt with in the ordinary way.—[*Indian Engineering.*]

THE GROWTH OF STUMPS.

It occasionally happens, particularly with trees growing in wet or very moist soils, that stumps of the Cuban pine (*Pinus heterophylla*) and long leaf pine (*Pinus palustris*) continue to grow by laying on very narrow annual rings of woody tissue for a number of years after the trees have been felled. The stumps of Douglas fir (*Pseudotsuga taxifolia*) and redwood (*Sequoia gigantea*) likewise continue to grow in diameter for a longer or shorter period of time. It was observed some time ago in Florida that a good many stumps of Cuban and long leaf pines felled more than ten years previous had continued to form annually new layers of growth. These annual rings are very narrow, often only from three to six cells wide, and are indistinctly visible even under the high power of the microscope.

What appears to puzzle the forester most of all is how the roots retain their vitality for such a long time and supply the cambium of the stump and larger roots with a sufficient amount of manufactured food to deposit layers of wood. Before the food material can be utilised by the tree it must be manufactured in the leaves. A chestnut tree, for instance, produces new shoots from the root collar as soon as it is felled and the leaves on these young shoots supply the root system with elaborated food. The stump thus continues to live, but the pines do not ordinarily produce stump shoots and cannot manufacture food material for themselves. It would seem reasonable to conclude, therefore, that the roots of these pines are parasitic and are grafted on those of the

neighbouring trees, which supply the pine stumps with the required amount of prepared food. The roots of closely allied species of trees often unite, especially in shallow wet soil, where the roots of both young and old trees are near the surface and necessarily come in close contact with one another.

The irregularity with which the wood is often deposited clearly indicates that the roots of only one side of the stump have joined those of the living trees. Sometimes the fresh wood deposited on one side is more than double that on the opposite side. This new wood produced is often scarcely distinguishable from that formed naturally. The fibres or tracheids are usually interlaced and in an isolated state are curved and have blunt ends. The markings on the cell-walls are similar to those of normally formed tissue. The compound microscope reveals the fact that the cell-walls are slightly thinner and that there is littlè or no distinction between the early and late wood in these narrow zones.—[*Scientific American.*]

DESTROYING MICRO-ORGANISMS ON SEEDS.

The method most generally in use for destroying the micro-organisms which occur on or in the coats of seeds is that which consists in washing the seed with an antiseptic, such as corrosive sublimate. A new process, which appears to give yet more satisfactory results, consists in immersing the seeds in commercial hydrogen peroxide. The peroxide destroys the micro-organisms and produces no harmful effect on the seeds, even though the latter be soaked in it for many hours. Moreover, it is said to exercise an accelerating influence on germination ; if this be true, the fact will be of considerable importance, as for example in the case of the seeds of many grasses which germinate with extreme slowness ; if they could be made to germinate in the course of a few days, not only would time be gained but loss from birds and ground animals would be reduced.—Pinory and Magron (*Bull. Soc. Botan. de France*, 59, 1912, 609, through *Gard. Chron.*, February 22nd, 1913, 121).—[*Pharmaceutical Journal.*]

CARDAMOMS.

After some years of depression, it is satisfactory to learn that the price of cardamoms this year has gone up. We take from Messrs. Schimmel and Co.'s semi-annual Report the following :—

The cardamoms of British commerce are all derived from *Elettaria cardamomum*, Maton, N. O. Zingiberaceæ which grows wild and is cultivated on the Malabar Coast and Ceylon. There is a large market for the spice in Calcutta; the annual consumption in India and Burma is computed to be nearly 1,000,000 lbs. Formerly scarcely any other than Malabar cardamoms were imported into Britain but the Mysore variety now affords most of the fine quality. The latter plant possesses a more robust habit and bears exposure better than the Malabar type. It is not known how the district name " Mysore " came to designate the variety of a cardamom plant. There appear to be two varieties of Malabar plants, var. *minus* being confined to Southern India and var. *majus* growing in Ceylon. The latter is distinguished by its shorter stems, broader leaves and more globose fruit. In the shady mountain forests of Canara, Cochin and Travancore the cardamom plant grows between the altitudes of 2,500 and 5,000 feet. The plant is best suited to a rich, moist, loamy soil protected from strong winds. These conditions are met with in the betel-nut and pepper gardens of Mysore and Canara and also in the cultivated cardamom valleys of Ceylon.

In the forest district of Coorg (Mysore) the cardamom gardens are laid out in February or March, simply by making clearings in the forest, a space of some 20 to 30 yards of jungle being left between the gardens. Superstition plays an important part, felling of the trees being only permissible on certain days of the week and before noon. The natives also believe that the presence of such plants as ebony, nutmeg and pepper favourably affect the development of the cardamom plants. In the fifth year a full crop is produced. After seven years more, the plant becomes sickly. Some of the large trees in the jungle-screen surrounding the fields are felled; the falling trunks kill many of the cardamom

stems, thus stimulating the rhizomes to produce new shoots, thereby renewing the producing capacity of the plot another eight years, when the process of renovation is repeated.

METHODS OF CULTIVATION IN CEYLON.

In Ceylon the cultivation is carried out much more systematically. The favourite cardamom districts are Matale, Medamahanuwara and Hewaheta. The undergrowth of the land intended for a cardamom plantation is cleared, holes are dug $1\frac{1}{2}$ to 2 feet wide, 12 inches to 15 inches deep and 7 feet apart in rows at a similar distance. The bulbs must not be planted too deep or they will rot. The use of seedlings instead of bulbs is increasing, however, the Mysore variety being most frequently grown from seed. Curiously enough only a small proportion of the seed germinates.

In Ceylon the plants flower almost all the year round ; picking begins at the end of August and continues until April. The fruit is carefully dried by exposure to the sun or in wet weather by artificial heat. Machines for removing the calyx-tube and the stalk have been introduced, and after passing through these the capsules are graded and treated with sulphur vapour.

A table given at the end of the article shows that the cultivation of cardamoms in Ceylon has been steadily increasing. In 1911 the area and export were 7,300 acres and 564,819 lbs. In 1910 they were 7,429 acres and 639,007 lbs.—[*The Planters' Chronicle in the Tropical Agriculturist.*]

TAPPING RUBBER TREES BY ELECTRICITY.

A novel electrical tapper for rubber trees is the work of a German in Peru. Hollow iron channels, divided into sections, are fitted on the tree-trunk, the sections containing pricking devices that can be worked at varying times by current from the central station. A receptacle in each section catches the latex, coagulating it with acid. The attachment may be left unvisited two or three months,

and in the time 200 or 300 lumps of rubber may be accumulated from a large tree.—[*Capital.*]

PROMOTING GERMINATION OF SEED.

The New York Cornell Station Bulletin 312 calls attention to the fact that a certain percentage of seeds, though possessing vitality, delay or fail to germinate owing to "hardness," but that early germination could be effected by the aid of sulphuric acid. It is advisable first to make a germination test to ascertain whether the percentage of germination of seeds, apparently alive, is low.

In the case of a small quantity of seed, it could be placed in a tube or other small glass vessel and a quantity of concentrated sulphuric acid, equal to about five or six times the quantity of seed, is poured over the seed. Stir the mixture thoroughly with a rod until all are completely coated with the acid. After standing for 15 to 45 minutes (according to percentage of hard seed) wash with water until the seed is entirely free of acid.

For large quantities a stone jar of 2 or 3 gallons capacity may be employed, and a wooden stick used for stirring.—[*Tropical Agriculturist.*]

THE OLDEST THING ALIVE.

People ninety years old are proud of their age nowadays, but even the nine hundred and sixty-nine years of Methuselah fade into insignificance before the tremendous age of what is thought to be the oldest thing alive—a cypress tree in the ancient Mexican city of Chapultepec. This tree, which measures a hundred and eighteen feet round, is said by expert botanists to be at least six thousand two hundred years old !—[*Timber Trades Journal.*]

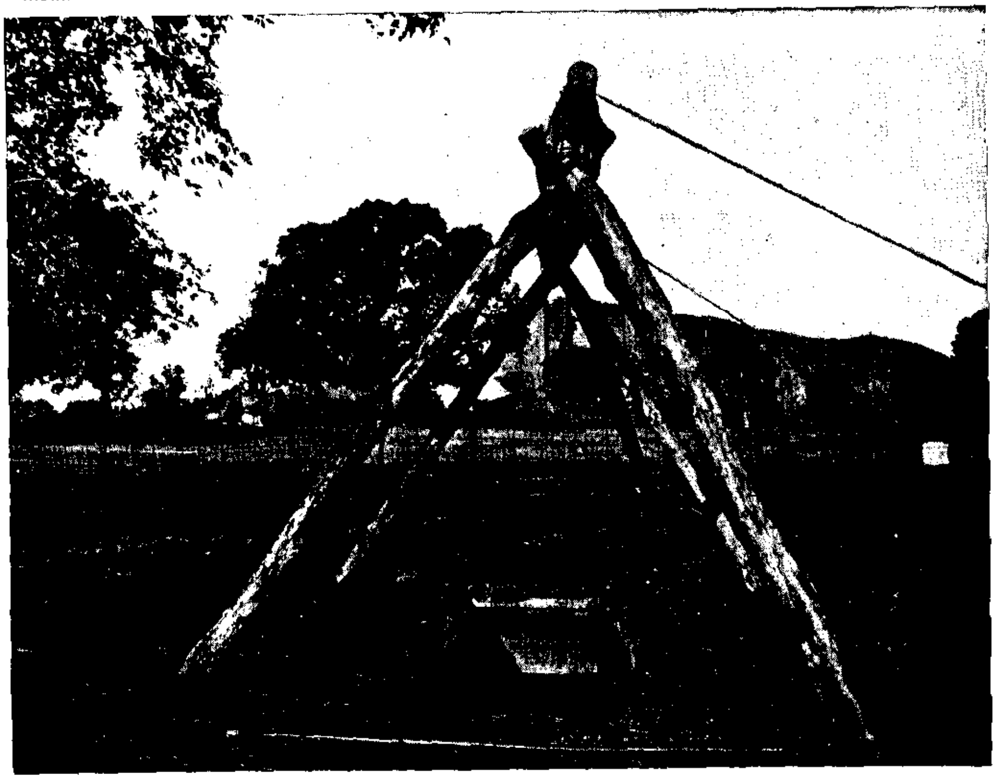
RED CAMPHOR OIL AS INSECTICIDE.

Dr. Sasaki, Professor of the Agricultural College of Tokyo University, has been experimenting with red camphor oil (one of the by-products of camphor), and finds that it is an effective remedy against wood-eating insects and white-ants.—[*Chemist and Druggist.*]

CURING PARA RUBBER BY HAND.

An interesting demonstration in hard-curing Para rubber by hand has been given at the Experiment Station, Peradeniya, Ceylon, by Mr. H. A. Wickham. The demonstration, says the *Times of Ceylon*, marks an important phase in the history of rubber production in the island, showing that it is now possible for the small land-owner and the goiya in the rubber districts to cultivate Para, convert the latex to rubber, and be thus assured of a good income. Hitherto the owner of a few rubber trees was not able to profit by them as he could not possibly invest in machinery to deal with the small output of latex, but with the inexpensive method of curing by hand he will now be in a position to prepare marketable rubber, which being smoke-cured, will be of a uniform quality. The method of curing which Mr. Wickham demonstrated is the same as that still followed by the Indians on the Amazon. All that is required is a small clay furnace with an opening on the top and at the side. A portable one made by a village potter answered the purpose admirably. It was charged with cocoanut shells and husk which were fired. The latex was ready in a pannikin alongside. Taking a mammoty handle which was the mould on which the block of hard-cured Para was to be built, Mr. Wickham held it for a moment over the flue from which hot smoke was issuing. A thin oily film was at once formed, and holding it over the pannikin, a few spoonfuls of latex were poured over the steamed portion of the stick which was twirled round so that a uniform coating of latex was formed on it. It was then shifted over the flue and, after a few turns, the milk-white

band had a straw colour and the rubber was cured. Another dash of latex and a few seconds steaming over the flue, and another film of rubber was formed. The process was repeated, and in a short time a mass of hard-cured Para was the result. Everyone was now anxious to have a share in the manufacture of the first sample of Ceylon hand-cured Para, but as the mould was getting heavier with the growing films a stand had to be rigged up so that the free end of the stick could be placed on it while it was being turned round and round. After a time the can of latex was all used up and a fine sample of hard-cured Para was ready. A few taps on a stone with the tapered end of the stick and the block of rubber slipped out of the mould to find a place among the other rare exhibits in the Peradeniya Gardens Museum.—[*Indian Trade Journal.*]



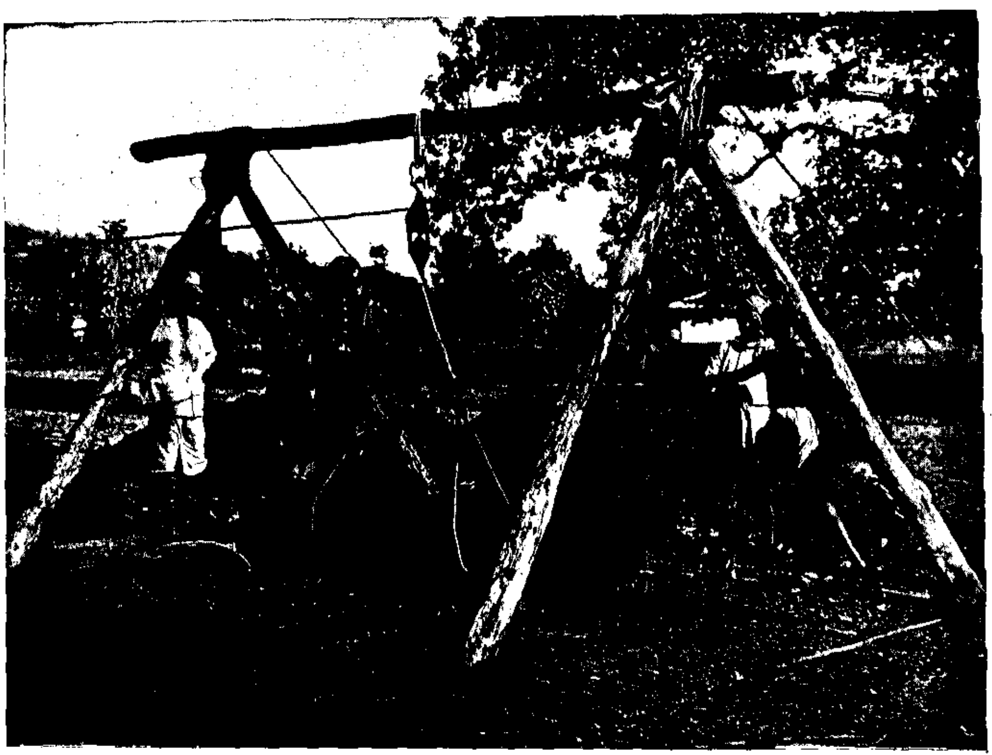


Photo.-Mechl, Dept., Thomason College, Roorkee. Photo. by R. S. Pearson, I. F. S.

Plant used for impregnating Timber, Betul, C. P.

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INDIAN FORESTER

AUGUST, 1913.

SPECIAL GRANTS OF TIMBER FOR DOMESTIC PURPOSES IN THE SAVOY.*

[*Translated for Indian Forester, by Mr. F. A. Lodge, C.I.E., Conservator of Forests.*]

Our modern legislation has often had an annoying tendency to get hold of some systematic ideas and to make the same uniform rules apply to widely differing regions, without taking into consideration local conditions which would justify a departure from a too inflexible order. We have a striking proof of this in the alterations which our legislation on communal rights has undergone. The Forest Code, in its original edition, was quite right in upholding the ancient customs regarding distribution and more especially in leaving to the communes the power to grant to the inhabitants the wood required for their new buildings and for the maintenance of their existing buildings, the only condition being that they must pay the value of the wood as fixed by experts.

The latitude which the municipalities retained in the distribution of wood for domestic purposes enabled them to weigh the

* Translated from an article by M. Daniel Mounal in the *Revue des Eaux et Forêts* of the 15th April 1913.

requirements of the villagers and to satisfy them as they arose. But this method of distribution, essentially variable from place to place, had in addition the serious drawback of wounding our ideas of democracy and equality, for by it the volume of wood delivered was in proportion to the importance of the buildings, that is to say in proportion to the apparent wealth of the owner. Therefore, with the double object of establishing throughout France the principle of equal distribution and a uniform method of grants of wood, the law of the 23rd November 1883, initiated by a Deputy of the Jura, Mr. Selièvre, made a clean sweep of all ancient customs excepting those based on title-deeds. This law, rounded off by those of the 19th April 1901 and 26th March 1906 only leaves to the communes the choice between the two following methods of disposing of the produce of their timber and fuel coupes; either the sale by public auction through the agency of the Forest Department, or equal distribution among the right-holders; either by the number of hearths or by the number of heads, or half by hearths and half by heads. All other customary methods are abolished, except those which are founded on title-deeds, which are exceedingly rare. *On this point the law is absolutely rigid*, but theories and systems cannot outweigh facts, and the absolute rigidity of the law explains why in many cases it remains a dead letter. The ancient customs are actually so well suited to certain local requirements, they apply so well to local circumstances and local needs, that they persist in spite of the efforts made to abolish them. Thus in the Savoy the ancient custom of giving communes and private persons special grants of wood continues to the present day.

This custom, which doubtless goes back to times of old, was brought under the law by the ordonnance for the administration of forests published by letters-patent of King Charles Albert on the 1st December 1833, as follows:—

"96. Those who have the right to take their communal wood, or high forest timber in the forests mentioned in article 2 present their demands to the Intendant of the Province, who must communicate them to the

administrations or owners of the forests for them to decide the position of the coupe required. The Intendant of the Province, after having received this information, and taken the opinion of the Forest Officer, gives the necessary permission, having due regard to such local customs as are not contrary to this ordonnance, and prescribes the precautions to be taken in working the coupe.

"97. In working the coupe the grantees must conform to all the conditions and measures laid down in the order of the Intendant under penalty of the same fines as are laid down in the case of purchasers of coupes in section II, Chapter IV, of this Act.

"98. Any person convicted of having sold any wood granted to him free of charge, outside the commune, shall be liable to a fine amounting to double the value of the wood sold unless any ancient custom to the contrary exists in the commune."

These grants used to be considered as a cause of the ruin of the forests, and this not without reason. Frequently they absorbed the whole of the possibility, ruined the crops by removing the healthy trees, and left standing only those which, being unhealthy or damaged, were unfit for use. Finally they gave rise to serious abuses; owing to want of control the villagers exaggerated their requirements and sometimes, with the connivance of the local authorities, secretly sold the wood granted. For more than half a century, since the 14th June 1860, the date of the annexation of the Savoy, the above law has been cancelled and the communal forests have been placed under the forest administration; but the French law in spite of its definite prescriptions has had to yield to the ancient customs which it wished to abolish, but which are, so to say, rendered necessary by local circumstances.

In the mountain regions, and particularly in the Savoy, a great deal of wood is used. Most of the buildings are constructed almost entirely of wood, masonry is often used only for the foundations; for want of tiles or slates the roof is made of shingles.

In the Alpine pasture lands, and in many hamlets, cattle drinking and stable troughs are rough hewn from the trunks of large pine trees. The population is scattered in a large number of hamlets, in farms and isolated houses, frequently far apart from each other, sometimes far from any cart-track. The pastoral mountains also contain hay lofts, stables, orchards and villas which are occupied during the season. Owing to the difficulty of transport, or the absence of roads, the owners cannot procure the wood necessary for the construction and maintenance of all these buildings except from the nearest block of the communal forests, unless their own estates contain some forest growth. Owing to a most commendable feeling of mutual support, the municipalities usually assist the indigent and the sufferers from a fire or from any other catastrophe by giving them a free grant of wood for the reconstruction of their dwellings. The upkeep of the municipal and rural roads and paths absorbs considerable quantities of wood, especially for the numerous rustic bridges formed of roughly squared beams thrown across torrents and ravines.

It is evident that the ordinary coupe, with its fixed boundaries in a given place in the forest, cannot meet such varied demands. Each particular case requires wood of a certain size, of certain quality, and situated as far as possible near the spot where it is to be used. These special grants supply undeniable needs and are perfectly justifiable. Thus the administration finds itself compelled by local circumstances to continue these grants, and its duty is limited to slowly but steadily suppressing the inveterate abuses of the system.

To this end, the following procedure has been adopted: petitioners are obliged to attach to their demands an estimate prepared by an expert, specifying the number and the kind of scantlings required. The municipality examines the demand, admits, rejects or modifies it, as it sees fit, and fixes the sum to be paid taking into consideration the position and income of the petitioner, or, in cases of poverty or catastrophe, recommends a free grant. The Prefect passes orders after taking the advice of the Forest Department, which holds an enquiry, checks the estimate,

and reduces it to the actual requirements. The permit fixes the position and size of the coupe, the sum to be paid, the time allowed for clearing and for proving the utilisation of the wood. The grantee may not use the wood for any but the specified purpose, under penalty of paying to the commune which owns the forest double the estimated value of the wood. He is also obliged to prove the utilisation of the wood within a given time limit, on the expiry of which his concession is held to have lapsed and all *wood not utilised is sold for the benefit of the commune.* The felling and clearing of the coupe is done by a responsible contractor, but may not be undertaken until the grantee has paid the amount due and signed an agreement binding himself to carry out the prescribed conditions.

Now let us examine how this practice, generally admitted and which follows almost literally the ancient ordonnances, can be reconciled with our modern legislation and the measures prescribed by the working-plans for the forests. On this subject we will distinguish between the grants made for the benefit of the commune and those made for the benefit of private persons.

It seems to us absolutely beyond the shadow of a doubt that the municipality has the right to remove from the ordinary coupe, prior to any distribution, the wood required for heating and maintaining communal buildings, for construction of new buildings, in short for carrying out all works which are useful to the commune, or which are carried out at the cost of the commune.

In our opinion there is no reason for not applying in this case the provisions of article 102 F, although this article, owing to an inexplicable omission, deals solely with public institutions.

It is no longer the same, when the grant is made to a private person. The law does not recognise any individual right in communal forests beyond the right to firewood. Therefore, whatever method of distribution is adopted, the shares ought to be equal for each of the right-holders, and none of them has any claim to a special share. These concessions of timber have therefore the character of private sales, and these are distinctly

prohibited by the Forest Code which insists on a public sale, and declares all other sales null and void.

On the other hand, these grants are not as a rule made from the *coupe of the year, but generally from a special* coupe, situated as near as possible to the site of the demands to be met, and this is undoubtedly a distinct departure from the regular order of fellings.

The orders of the Prefecture issued on these grants are therefore absolutely illegal, for the Prefect has no power to authorise the felling of coupes outside the regular prescriptions of the working-plan, and he cannot in any case give to a private person a right which the law refuses to give. There is no doubt that such orders would be cancelled if they were referred to the court of appeal by anybody whose interests suffered from them, especially by a fuel right-holder whose share had been reduced by a grant of this kind.

Vain attempts have been made to give these grants a cloak of legality by quoting the ordonnance of 1827 or old ministerial decisions which in cases of proved urgency allow the Prefect to give the right-holders their grants of timber and to authorise, as an exception, the formation of special coupes, on the condition of having their orders confirmed by competent authority. These rulings, which only regulate a few details of administrative procedure, are without value on the question before us, and it is quite wrong to call these, as is commonly done, concessions of timber for emergencies. Although, since the forests of the Savoy have been placed under the forest administration, the Forest Department has steadily endeavoured to restrict the grants of timber, they are still of great importance, as the following table, dealing only with the Savoy, shows :—

Year.	GRANTS FOR THE BENEFIT OF							Total.			
	COMMUNES.			PRIVATE PERSONS.							
	No.	Volume m.c.	Value fr.	No.	Volume m. c.	Value. fr.	Revenue realised fr.	No.	Volume m. c.	Value fr.	Price per cubic metre fr.
1908 ...	46	1,203	12,589	83	3,636	38,473	26,331	129	4,839	51,062	10·55
1909 ...	40	985	12,011	84	3,341	38,403	21,119	124	4,326	50,414	11·65
1910 ...	41	972	12,010	78	3,431	38,888	22,046	119	4,403	50,098	11·55

The restrictions which have been imposed on these grants and the supervision exercised over the actual use made of the wood have reduced them to the most justifiable requirements, and at the present time they do not seriously interfere with the working-plans. One may indeed foresee that they will diminish regularly in the future. The development of rural roads which bring the most isolated villages into touch with the main roads and the improvement of export tracks in the forests have caused a noticeable rise in the price of timber, and nowadays it is used more carefully and economically than in the days when the difficulties of transport rendered it almost valueless. In new buildings less and less use is made of wood, its place being taken by masonry which among other advantages materially diminishes the danger of fire. As a result of the development of sanitation and comfort the old-fashioned wooden troughs, always narrow and difficult to keep clean, are being replaced in hamlets and mountain farms by large stone or cement reservoirs, easy to clean out and more suitable for most domestic purposes. In many cases it will also be advantageous to replace wooden bridges, which are constantly requiring repairs, by bridges in stone or iron very much stronger and lasting for an indefinite time. Finally the municipalities, compelled to meet ever-increasing expenses, are trying to increase the income derived from their forest estate. They are therefore less and less disposed to give an indulgent hearing to the demands which are made to them, or they require increased payments in return for concessions granted, and thus steadily discourage new demands.

However this may be, these personal grants meet local requirements and the needs of the population so well that they can never be entirely abolished. We have seen that they were contrary both to the letter and the spirit of our laws, and in fact they have only continued to exist, thanks to the toleration of the administrative authorities.

But this toleration leaves an open field for arbitration. The municipalities find themselves called upon to pass absolutely final orders on the demands which are made to them. They are free

to accept one demand, however groundless it may be, to adjourn or reject another demand which may be most justifiable, to make a free grant to one person, and to demand an exorbitant payment from another. There are very few countries where family feuds, struggles for influence, political and religious rivalry do not exist, and the side which wins, the one which holds the majority of the municipal council is only too often led to profit by its victory by crushing its rivals and favouring its friends. The unlucky landowner to whom a hostile municipality systematically refuses any grant, is helpless, without power to appeal. He may see his buildings fall to pieces or destroyed by fire, and be unable to reconstruct them. The law itself supports this injustice, for it says that he has no *right*.

The law-maker of 1883 tried, above all things, to bring about a democratic reform; according to his statement he wished *to abolish the last traces of the feudal system.* He has succeeded perhaps in abolishing a few abuses, but preoccupied principally with theory, he failed to provide for the legitimate interests of the Alpine population, he has deprived them of a common right absolutely necessary to their existence, for they could no longer exist if they were refused the right to take from the forests which form their patrimony, the timber necessary for the construction of their new and the maintenance of their existing buildings.

To resume: the administrative proceedings which so frequently sanction personal grants of timber are in clear opposition to our laws. This contradiction is most awkward; it proves clearly that the law cannot be strictly applied to the distant valleys of the Alps without injustice, and it seems to us that the remarks we have made are not without interest at the time when the revision of the Forest Code is in progress.

(Sd.) DANIEL MOUNAL.

SOME NOTES ON THE *TAUNGYA* PROBLEM IN THE SHAN STATES.

The words *taungya* and *ya-cutter* are perhaps the most hardly used words of the whole official vocabulary of Burma. They are used to describe a variety of methods of agriculture and their cultivators. By their use thus loosely the most careful ya-cutters are lumped together with the worst. It is as if one were to accuse the farmers of the Eastern Counties of uneconomic agriculture because both they and the crofters of the Western Highlands go in for farming.

Taungya-cutting in the Shan States shows every stage of development from the pure shifting cultivation of nomadic tribes to fixed methods of agriculture hardly distinguishable from those practised in Europe and it is a great pity that in too many official reports sufficient distinction has not been made when treating of tribes who practise other methods than that of permanent wet cultivation.

Again there is a very frequent failure to emphasise the point whether the particular tribe cuts its "yas" as a substitute for or as a supplement or complement to wet cultivation.

Apart from those tribes whose extremely nomadic habits prevent them from attempting to take up permanent wet cultivation, the more settled races must have some reason for substituting taungya for wet cultivation. Some would no doubt give general cussedness and laziness as the reason, but this can hardly be so in reality, since I have never met a tribe yet where the owner of wet cultivation was not looked on as a man of substance and position.

The two main reasons which undoubtedly carry weight in the Shan States are :—

That taungya requires no outlay of capital in the direct form of money and little in the indirect form of labour for deferred results.

That it leaves the ya-cutter complete freedom to live where he likes and to shift his home when he likes. Also it allows him to suit his crop to his own taste or that of the market,

but as in the majority of cases paddy or some other grain staple is practically the only crop this reason may be left out of account. In some parts mere sentiment or clannishness may make a tribe stick to old-fashioned ways.

The first is obviously the most pressing reason in a country such as the Shan States where money has been none too plentiful and the second is hardly less so.

With the example before us of villages removing in a body from the neighbourhood of reserved forests in spite of ample exclusions and privileges, together with the regular migration from certain states to others owing to the exactions of chiefs and minor officials, it is easy to understand that the average ya-cutter is not going to invest his money and labour in making a property which may afterwards prove more burdensome than profitable to him.

Taungya when merely complementary to wet cultivation is not likely to affect large areas of forest, but will require consideration when any scheme of regulating and systematising taungya cultivation is taken in hand. However great the extension of permanent cultivation in broken country, a certain amount of taungya is bound to continue alongside it as its indispensable complement in supplying the needs of the inhabitants.

The question of taungya as a supplement to existing or future wet cultivation is one that is bound to increase in importance every year. It cannot be expected that the increase of wet cultivation will keep pace with the increase of population due to natural increase and immigration. While immigration is likely to affect the more open parts of the country, the natural increase of the tribes working in the broken country will certainly cause serious difficulties sooner or later. This will be particularly the case where the tribal areas are already fairly closely circumscribed and where tribal customs tend to prevent the members from emigrating. The states of the extreme south-west are a case in point.

TYPES OF TAUNGYAS.

Dry as opposed to wet cultivation in the Shan States may be roughly divided into four classes or types, which are of course not

rigidly separable since they blend into one another to form a number of mixed types. However over distinct areas or among various tribes one or other of these four will be found to predominate :

I. Purely nomadic.
II. Semi-nomadic.
III. Settled but unsystematised.
IV. Settled and systematised.

Type I.—Under this come the Lihsaws and the Mühsö tribes who are constantly on the move and confine themselves to cutting high forest and practically virgin forest at that. A Mühsö headman once told me that as far as he could remember his village had never once cut over an area twice nor one which had been previously worked over by anyone else. The amount of forest abolished by one village in the course of one man's lifetime can be easily imagined. In this type of taungya the "ponzos"* are never fire-protected.

Type II.—This is practised by a number of tribes and is found over widely separated parts of the Shan States. It is worked by Shans, Danus, various Riang tribes and certain of the Taungyos and Taungthus. Since it is practised by such a variety of tribes over such a wide area, it seems to be due less to the customs of the individual tribes than to the nature of the forest in which they have accustomed themselves to work. It seems to prevail in the drier forests such as "Indaing" and the lower dry belt (2,500—4,000 feet).† It differs from type I in the longer stay of the

* By "ponzo" I refer to an abandoned taungya from the reaping of the last crop to the time when the ya is cut over again or returns to high forest.

† NOTE.—The forests of the Shan States may by very roughly divided into the following belts :—

Altitude.	Forest type.	Important species.
1,000—2,000 ...	Lower evergreen, mixed, moist.	Teak.
2,500—3,500 ...	Lower dry ...	Ingyin, some oaks, thitsi, *Pinus Merkusii*.
3,500—6,000 ...	Upper dry ...	Oaks, *P. Khasya* (off the limestone).
Over 6,000 ...	Upper evergreen ...	Rhododendrons.

villages, in working over ponzo (though usually very old ponzo approaching high forest) and in the village migrations being confined to relatively limited regions for appreciable periods. The ponzos are not fire-protected. It represents no doubt the transition between type I and type III.

Type III is the commonest type of taungya in the whole of the Shan States, and since it is practised in the most accessible and thickly populated parts, it attracts the attention of the greater number of officials who visit the States. It is also the taungya method of the Shans proper as it extends over the whole length of the open country eastwards from the great depression of the lake valley—Namlang—Namtu to the Salween together with the part of Hsipaw State lying outside this. I have described it as settled and it is in so much that the villages are practically permanent and the areas in which they work are defined and recognised as belonging to a particular village community. Further in this type we see the start of individual ownership of the land. Enquiries seem to show that the prior right to cut over any particular piece of ponzo rests with the person who last worked that patch and that such a right extends over the average fallow rotation of the neighbourhood. If not exercised by the end of this period anybody can jump the claim. Under this method there is no regular system of working, the end of the fallow period is determined more by the appearance of the ponzo growth or by the needs of the owner than by anything else, with the inevitable result that the fallow period (*i.e.*, the taungya rotation) tends to diminish regularly. This progressive diminution reaches its minimum at a rotation of roughly six or seven years and if pursued after that leads to the disappearance of any real woody ponzo-growth and to the removal of the village or to the adoption of methods described under type IV.

It seems probable that the troubled times preceding the occupation of the Shan States by the British forces prevented this type of taungya from working out its evolution to a final stage and allowed the forest growth to improve considerably

over a large part of the most disturbed area. Had this method of taungya cutting been able to proceed uninterruptedly for the last fifty years combined with the natural increase of population, we might reasonably expect to find that the method of taungya over the above area approximated much closer to the dry field cultivation of the Myelat plateau quoted under type IV. As a rule the ponzos are not fire-protected under this method.

Similar settled but unsystematised taungya is worked by some of the Karens in western Karenni, some of the Pale in the central hills of the Shan States and some Kachins of the northern states, which in spite of local differences clearly belong to the type just described.

Type IV.—Under this heading have to be massed a variety of local methods showing considerable apparent differences between each other but falling into two classes. As they undoubtedly show the highest stage of development of taungya working, I propose to take them separately.

(*a*) DRY CULTIVATION OF THE MYELAT PLATEAU.

As opposed to wet paddy cultivation this must be called taungya, although it bears little resemblance to the popular idea of taungya. It is in fact the primitive "open field" cultivation of England in the days before the land was enclosed. As then there is a long fallowing and little or no manure is used. Brushwood, weeds, or dry cowdung are burnt under the heaps of loose soil as is done elsewhere throughout the western states, but the object of this is more to break up* the heavy clay which forms the soil than to get the manurial value of the ash. In this sub-type a regular rotation of three to five years is followed and

* NOTE.—By this I refer to the chemical not to the physical changes. Dehydration or coagulation of the clay is an indispensable process with this soil, as anyone who has tried gardening up there knows. *C.f.* A. D. Hall's "The Soil," pp. 235 *et seq.* on paring and burning.

the cultivator enjoys a right of almost permanent ownership over the areas worked by his household.

Whether this part of the country was forest covered or not within relatively recent times is a much discussed question, but whether it was or not this type of taungya seems to be the logical successor to type III in regions of similar soil and climatic conditions. The ponzo (in this case fallow grass-land) is universally fired every year.

So many mixed races inhabit the Myelat that it is difficult to point to any special tribe as working this method in particular. I should be inclined to give the credit of bringing this method to its present pitch of development to the Taungthu, who, apart from the tribes mentioned under the next heading, appear to be the thriftiest ya-cutters in the Shan States.

(*b*) TAUNGYA OF THE PAUNGLAUNG (SITTANG) DRAINAGE.

For those interested in the taungya problem a trip through the Paunglaung drainage from where the main Paunglaung enters the State of Loilong to the source of the Paunglaung Nge in the Bawlake enclave is of the greatest interest. There one can see the highest development of taungya on steep hillsides attained by the inhabitants themselves without outside intervention and at the same time get a very good indication of what can be done to change taungya from being the *bête noire* of the Forest officer and the despair of everyone else to a generally acceptable form of agriculture.

True, this drainage has enjoyed conditions more favourable than those of other parts of the Shan States. The climate is moister, the soil if not richer is more kindly and the region has suffered less from civil commotions. On the other hand, from its position the inhabitants have had no chance of relieving by emigration the pressure on the land of an increased population, while the tribal customs are also opposed to it. That this pressure has been distinctly felt is shown in the southern valleys by the pitch to which wet cultivation has been carried. Terraced

fields may be seen carved out of the slopes to the highest point at which a perennial supply of water can be found. Frequently the terraces are only a bare 4 feet wide with a vertical drop of over 4 feet between the terraces. The principal tribes inhabiting this area are the Padaung, the Zayein, and the White Karen.

The chief features of their method of taungya are :—

(1) Strict fire-protection of the ponzos.

(2) Definite rotations for various blocks of forest according to its nature.

(3) The yas cut by all the members of one village are conterminous and form one large ya.

(4) Grazing is confined mostly to the valley bottoms (especially amongst the Padaung) or to forest not used for taungya (White Karen). Almost all these features are wanting in taungya practice in other parts of the Shan States.

Amongst the Zayein and Padaung including the few Bre along the southern watershed, the villages are permanent and frequently number 50 to 100 houses. Among the white Karen who occupy a larger area in proportion to their numbers than the other tribes, the villages shift periodically, following the position of the blocks due for working. The forest in each village sphere is definite and the future sites of the villages are usually those of the former rotation. The ponzo growth under such conditions is remarkable; in the moister areas a dense growth of soft-wood trees and high grass comes up which is practically impenetrable without the help of a dah. In the higher and drier zones the growth of coppice is excellent, a complete soil covering being established in a couple of years. In some situations *Pinus Khasya* sows itself from adjoining trees and flourishes better than in many a plantation, which, considering how rapidly pine disappears off ordinary taungya land, is in itself an excellent witness to the soundness of this type of taungya. The maximum rotation found was 50 years for rocky ground with a S.-E. aspect, the minimum 7 years for moist forest.

Fire-protection over the ponzo land is very strict throughout, but amongst the White Karen who do not work up to the highest elevations as do the remaining tribes, the zone above the ponzo belt is often fired, partly for grazing but more to form a natural fire-trace.

This completes the rough survey of the chief types of taungya found in the Shan States.

[*To be continued.*]

ANALYSIS OF GUTTA MADE FROM THE LATEX OF *PALAQUIUM ELLIPTICUM*, BENTH.

BY PURAN SINGH, F.C.S., FOREST CHEMIST.

In the triennial programme of the Forest Research Institute for the year 1910-11 to 1912-13, it was proposed to study the possibilities of utilizing the milk of *Palaquium ellipticum*, Benth., but unfortunately on addressing local officers with the object of obtaining samples, it was found that no regular supplies of the latex could be obtained even from localities in which it is stated to occur. The Conservator of Forests, Southern Circle, Bombay, writes that this tree does not occur in his circle. Apparently also it does not grow in North Canara although this has been given by Brandis as its habitat.

Owing to the scarcity of the material the enquiry was confined to the analysis of a sample of latex received in the fresh state from North Malabar, Begur Range. In addition two more samples of raw gutta made in the Laboratory from two specimens of semi-solid, half coagulated latex, received from South-Western Circle, Tenmala, Bombay, and from Termalai, Travancore, were examined.

THE ANALYSIS OF THE MALABAR LATEX AND THE GUTTA FROM IT.

A bottle of clear milk-white emulsion was received from North Malabar, Begur Range. The sample was practically free from mechanical impurities such as bark, etc., as a preliminary

filtration through muslin served to show. The specific gravity was (at 25° C.) 1·0062 and it showed a distinct acid reaction, 100 cc. of the latex requiring 21·60 cc $\frac{N}{10}$ KOH for complete neutralisation.

It was coagulated by a mixture of creosote and alcohol in the proportion of 1 : 20. The impure coagulated gutta was worked into "biscuit" form and digested thoroughly with water in order to remove the soluble carbohydrates, organic acids and inorganic salts. The resulting product was then dried *in vacuo* till constant in weight. The nitrogen was determined by the method of Kjeldahl and the ash by incinerating the residue obtained by drying the latex over a water-bath.

RESULTS.

Water containing acids carbohydrates, etc....	80·17 %
Raw gutta	19·29 %
Proteids...	9·24 % (Nitrogen being 0·385 %).
Ash	0·30 %

The percentage of gutta is very low but the latex was a very thin milk-like homogeneous emulsion collected in the rainy season. The analysis of the raw gutta obtained from this latex gave the following results :—

Moisture	0·37 %
Pure gutta	31·29 %
Resins	62·31 %
Insolubles	4·13 %
Proteids	1·90 % (Nitrogen being 0·304 %).
Ash	0·9 %

The gutta obtained was pure white in colour, but it was hard and brittle when cold.

The two other samples of the latex from Tenmala, South-Western Circle, Bombay, and Termalai, Travancore, were received in semi-coagulated state. Both the specimens had undergone some fermentation and were very thick emulsions as compared with the sample received from Begur. They were coagulated with creosote and alcohol and the raw guttas obtained as mentioned above.

The gutta made from the latex received from Tenmala, Bombay, gave the following results:—

	As made.	Calculated on dry material.
Moisture	23·38	...
Pure gutta	21·78	28·37
Resins	49·30	64·42
Insolubles	5·27	6·86
Proteids	0·27	0·35 (Nitrogen being ·043%)
	100·00	100·00
Ash	2·21%	2·88%

This gutta was pure white in colour and was not so brittle as those from Begur and Travancore.

The gutta made from the latex received from Termalai, Travancore, gave the following percentage composition :—

	As made.	Calculated on dry material.
Moisture ...	19·22	...
Pure gutta ...	27·15	33·61
Resins ...	48·89	60·52
Insolubles ...	4·50	5·57
Proteids ...	0·24 (Nitrogen being 0·039%)	0·30
	100·00	100·00
Ash	1·22%	1·51%

This gutta had a pinkish tinge and was as brittle when cold as that obtained from Begur.

The above analyses of the *Palaquium*-gutta obtained from the localities mentioned, prove the material to be of inferior quality. The best gutta should contain at least 70—85 per cent. of pure gutta and resins should not exceed 20 per cent. The gutta from this tree shows 60—64 per. cent of resins alone. The quality of this gutta being so poor, and the quantity available being apparently inconsiderable, it seems to be of little commercial importance.

A PLEA FOR UNIFORMITY AND SIMPLICITY IN RECORD KEEPING IN FOREST OFFICES.

A Forest Officer spends so many months of the year in camp that he is rarely able to properly control the work done by his clerks and often in practice makes no great effort to do so. He regards his office work as a means to an end and in the nature of a disagreeable necessity. There is no doubt, however, that a well run office is like the oil in an engine; anything that clogs the oil being bad for the engine. A great failing in many offices is the want of method in record-keeping. It is not uncommon for a Head Clerk to ascribe delay in putting up cases to illness on the part of the record clerk. The method usually followed in record-keeping is somewhat complicated and frequently not understood by the young Divisional Forest Officer and in some cases only within the comprehension of the record clerk.

The present procedure is as follows:—

A letter with a number and a date having been received in an office is then registered. This means an entry in a big volume where it is given a case number. If this is an opening letter of a new case a fresh entry is made in the Case Register from whence the last number is reckoned. The letter is then cased and filed in its proper place. This sounds very simple, but in order to find this letter subsequently and this is mainly the *raison d'être* of the registration, the record clerk has to look it up, first in the Letter Register to find the case number and then in the Case Register to ascertain the file. Files are kept in pigeon-holes in any order that may occur to the record clerk. Few offices have the same names for their files or the same number of files, some taking the Budget names, others Annual Report names, and so on.

Methods of pigeon-holing also vary in different offices, some keeping several years' records in one set of racks. In some offices a new case is opened annually, in other offices cases are allowed to run on with the same number. There is no reason, however, why a more uniform and simplified system should not be introduced in all offices in one Circle or Province at any rate and the following has been found to work well.

Forest work falls into more or less stereotyped lines and the same file names may be used throughout all Divisions. Pigeon-holes to start with might be labelled with the file names in alphabetical order such as Accounts, Budget, Building, Establishment, Fire-protection, Grazing, and so on. File headings rarely exceed 35 in number in any forest office, and although one file may occupy more than one pigeon-hole the files in the largest Divisional office would hardly fill up a 40 pigeon-holed rack in any one year. Instead of cases being numbered they might come under headings in a sub-file. Under Establishment for instance the sub-files would naturally fall under such sub-heads as (*a*) Gazetted Officers, (*b*) Rangers, (*c*) Deputy Rangers, (*d*) Foresters, and so on. Buildings and Roads files would subdivide into (*a*) General, (*b*), (*c*), (*d*), etc., each being a sub-file relating to one particular road or building under construction. It is improbable that there would be more than 26 sub-files in any one file; the last sub-file or case in many pigeon-holes being "Miscellaneous."

The Register of Cases would contain *one page* for *each file* and would after a time cease to vary from year to year and become stereotyped. A copy of one such page mounted on a card might also be placed on the top of the file in each pigeon-hole to facilitate reference in the absence of the Register. The bulky Letter Register might also be reduced in volume. The unwieldy "Subject" column being dispensed with altogether, all entries could be made on *one* side of the (foolscap size) register, the headings of columns being merely—

1. Date.
2. From or To.
3. Number of letter.
4. Name of file and sub-file.

A letter regarding a Deputy Ranger's leave would come into the last column as Establishment (*c*): (*c*) being the sub-file.

This method of arrangement of files would enable any clerk to find a case without, in nine cases out of ten, having to look up any registers whatever, the latter being

only used in the last resource. The work of finding a case would in fact be comparable to the looking up of a word in a dictionary. Unless cases become very bulky owing to delay in their disposal, it is usually convenient in small offices to keep a case running on from year to year until it is finally disposed of and the above system obviously favours this practice. For the sake of clearness the adoption of the Calendar year may be supposed. Two racks should be employed each containing some thirty odd pigeon-holes and labelled 1912 and 1913 respectively. Any letter received after the 1st of January 1913 referring to a 1912 case would have the effect of transferring that case to the 1913 rack. In a couple of months' time most if not all of the pending cases in the 1912 rack would thus automatically find their way into the 1913 rack. By January 1914 all cases left in the 1912 rack can be tied up in bundles and relegated to the main record-room from whence, since there had been no reference to them for 12 months, they would rarely emerge till the time came for their destruction. At the time of transfer a good many of the 1912 records might well be destroyed then and there. The old 1912 rack having been cleared out would then be ready for the 1914 records and so on *da capo*.

The present procedure in offices is more or less based on the sixth edition of the Forest Code. All reference to office work has however been omitted from the seventh edition of the Code and the present time is suitable for the introduction of a simpler method of Letter Filing than is usually at present in vogue.

The method outlined above is suitable for Divisional offices but it would probably require modification in the case of Circle offices. The carrying forward of cases is apt to make a Conservator's file too bulky for postal purposes when camping. There is however no reason why the pigeon-holes in a Conservator's office should not be labelled in alphabetical order and, in some of the files, sub-files might perhaps also be formed relating to different Divisions.

F. T.

THE COMPOSITION OF CEARA RUBBER FROM COORG.

BY PURAN SINGH, F.C.S., FOREST CHEMIST.

The other day I received a sample of Ceara rubber grown in Coorg from Mr. William Raitt for analysis with a view to see how it differed from similar rubbers grown in other countries. It was in the form of a thin translucent sheet of amber colour. It was a clean and well prepared sample exhibiting very good elasticity and tenacity.

The following table gives the composition of five samples of the Ceara rubber obtained from different places as analysed at the Imperial Institute, London, the details of which have been taken from the Bulletin of the Imperial Institute, 1911, Vol. IX, No. 1, and also of the sample mentioned above recently received from Coorg, as analysed at Dehra Dun :—

No.	Country where grown.	Moisture.	Caoutchouc.	Resin.	Proteid.	Ash.	Remarks.
1	Ceylon ...	0.9	91.3	3.1	3.4	1.3	Analysed at the Impl. Institute, London.
2	Uganda ...	3.5	86.1	5.7	3.6	1.1	
3	East Africa Protectorate.	12.4	58.9	10.5	12.1	2.4	
4	Nayasaland ...	4.9	78.6	10.8	8.4	2.2	
5	Sudan ...	2.2	80.1	5.8	9.8	2.1	
6	Coorg ...	0.85	82.91	11.24	4.10	0.90	Analysed at Dehra Dun.

From this table it is clear that as regards the percentages of moisture, caoutchouc, ash and proteids, the Ceara rubber from Coorg is similar to the Ceara rubber grown in other countries, but the percentage of resins in it is high.

In the above table, only two samples, one from East Africa Protectorate and the other from Nyasaland, show a similar percentage of resins. The Ceara rubber from Ceylon of the composition given above fetches the best price and is considered to be of excellent quality. Compared with it the Coorg rubber is inferior because of the excess of resins.

NOTE ON THE TREATMENT OF *TERMINALIA TOMENTOSA* SLEEPERS IN THE BETUL DIVISION, CENTRAL PROVINCES, WITH CHLORIDE OF ZINC AND *AVENARIUS CABOLINEUM* OIL.

In the July 1912 number of the *Indian Forester* a note appeared on the treatment of *Pinus longifolia* and *Pinus excelsa* sleepers with *Avenarius carbolineum* oil. All creosote oils are somewhat expensive, though most useful antiseptics with which to treat sleepers. To reduce the cost of treatment it may be found possible to mix them with cheap earth-oils, but up to date no experiments have been carried out in this connection by the Forest Department. In America and elsewhere attempts have been made with success to reduce the cost by a method of mixed impregnation, by which timber is treated with a cheap salt and oil. The salt and oil cannot be combined sufficiently uniformly for working purposes so that the timber has first to be treated with the salt, and when dry dipped into the oil.

The principle of combining a salt and oil and an earth and creosote oil together, though both carried out with a view to cheapening the process, are not quite the same. In the case of the salt it is to protect the timber and the oil, though also applied for this purpose, has a double function in that it also prevents the salt from being washed out of the timber. On the other hand the idea of adding earth-oil to that of creosote is to distribute the latter over a greater area and still keep the price of treatment constant, if not less.

This note deals directly with the impregnation of 300 *Terminalia tomentosa* B. G. sleepers in Betul, though 900 *Dipterocarpus* M. G. sleepers have also been treated in a similar manner at Pyinmana in Burma.

The tank was similar to that used and described in the previous article on this subject. See photo of the one used in carrying out these experiments in Plate 8.

The object aimed at in treating the *Terminalia tomentosa* B. G. sleepers was first to impregnate them with 3 or 4 lbs. per cubic foot of a 2 per cent. solution of chloride of zinc and then to give them a coating consisting of 3 lbs. of *Avenarius*

carbolineum oil. The difficulty anticipated was to make them take up as much as 4 lbs. per cubic foot of the chloride of zinc solution, the wood being dense and hard.

Experiments were carried out in order to ascertain the rate of absorption. First a batch of 15 sleepers were treated for $21\frac{1}{2}$ hours, at a temperature of 75° C. for 3 hours and then allowed to cool down. The average absorption was 3·4 lbs. per cubic foot. The next batch were treated for 24 hours, temperature 60° C. for 3 hours and then allowed to cool down. The absorption was 2·55 lbs. per cubic foot. A third set were treated for 24 hours at a temperature of 80° C. for 5 hours and then allowed to cool down. They absorbed 3·7 lbs. per cubic foot and on this basis the rest of the sleepers were treated.

The sleepers were then dried for 7 days, after which they were found to have gained their normal weight and were then treated in the oil of which they absorbed 3 lbs. in 5 minutes. A somewhat curious point has been observed in connection with these experiments and that is that a sleeper first boiled in a hot water solution, such as 2 per cent. of chloride of zinc, after drying absorbs a second solution much faster than if it had not been previously treated. This is probably due to the fact that when the timber is subjected to excessive heat the sap and moisture is driven out and the pores and cracks cleared, making absorption easier after the timber has had time to dry.

The total cost of treating the sleepers, based on a 5 per cent. cost for plant, which can be used again, came to Rs. 3-9-0 including the cost of preparing the sleepers, which amounted to Rs. 2-8-0 per sleeper. The cost of treatment comes to Re. 1-1, which is of course excessive, but as the salt and oil were purchased at retail prices and had to be railed from Calcutta and Agra respectively and carted 32 miles to Shahpur, while the tank made locally had to be carted 29 miles, put into position and a flue built, etc., all of which is included in the Re. 1-1-0 it is thought that were the work to be carried out on a large scale, in a really suitable locality, the cost could be reduced to about half.

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Forest Economist.

THE CORK OAK AND ITS PRODUCTS.

In the *Indian Trade Journal* of June 6th, 1912, attention was drawn to the possibility of growing cork in India.* On the authority of experts in Forest Economics, who had been consulted, the opinion was expressed that though cork was not grown in this country there was no reason why it should not be grown on the warm and dry slopes of the hills of the various ranges. Readers will therefore be interested in some account of an article about cork which appeared in a German periodical, and is summarised in the *Bulletin of Agricultural Intelligence and of Plant Diseases*. The article relates more particularly to Portugal, which is one of the principal sources of cork. It is estimated that in that country the cork tree (*Quercus suber*) occupies an area of 519,000 acres. In south and central Portugal, the cork oak shows its usual habit; its stem is normally short and its growth compact. It branches at from 5 to 10 feet above the ground and forms a spreading bushy crown.

In the north, on the contrary, where this species occurs mixed with *Pinus maritima*, its trunk is more slender and often attains a

* This article was reproduced in the *Indian Forester* for August 1912, page 422.

considerable height ; but this change of habit is also due to the method of pruning adopted. Here, too dense a shade is avoided as space is needed for intercalary crops, while in the south, where the cultivation is less intense and the estates larger, more stress is laid upon a greater production of cork and acorns. In the north, the development of horizontal branches is encouraged, which are carefully pruned in order to expose the crown to the effect of light and air.

The flowering and fruiting seasons and the time of the fall of the acorns are at approximately the same dates as in other Mediterranean countries. Sometimes cork oaks attain quite large dimensions. As an example, the writer cites a tree growing in the Estremoz district, which in one season yielded 3,960 lbs. of cork. As regards their growth, many young plantations yield cork fit for use 23 years after planting, while male cork is produced sooner, but the latter cannot be used in the manufacture of bottle-corks.

The acorns are devoted to the fattening of pigs, although they are more bitter than the fruit of *Quercus ilex*. It is estimated that of the million pigs which are reared annually in Portugal, one-third are fed on acorns of the cork oak and holm oak *(Q. ilex)*. The total harvest amounts to 200,000 tons. If the proprietor is not himself a pig-breeder, he farms out the oak forest at the rate of from 20 to 25 shillings per head of swine to be fattened. The number of these animals to be fattened in a forest is decided empirically. As a rule, the ground beneath the oaks is kept free from underwood and bushes ; this promotes the growth of intercalary crops, obviates any danger of forest fires, and enables the pigs to find the acorns with greater ease. The formation and ripening of the cork is hastened by tilling the ground, manuring for intercalary crops, and by the pigs during the fattening season. The cork is finest and thickest when it has formed quickest. All existing cork oak forests are of natural growth, and most new plantations that are made arise by protecting a certain area against pigs and fire.

Lately, new plantations are made by sowing late autumn acorns which are preferably obtained from oaks already known to be

good cork producers. The acorns germinate very rapidly, the young trees require no further care, and on good soil, the first crop of male cork can be stripped off at the end of ten years. Planting is rare and only occurs for small stands, or in order to fill up gaps. The cork oak forests are almost exclusively the property of private individuals, who either strip off the cork themselves, or lease the forest for 20 to 40 years.

By the terms of the contract, the owner is often obliged to strip off the male cork and to superintend the clearing of the crown, etc. The tenant always undertakes to leave untouched the cambium layer. The male cork is usually removed when the trees are from 15 to 20 years old. The operation generally takes place between June 1st and August 30th, but is sometimes, though not frequently, effected in the second half of May. An interval of 9 or 10 years, often of from 8 to 12 years, intervenes between each stripping; this time is necessary to obtain cork 32 mm. ($1\frac{1}{4}$ in.) thick. In order not to weaken the tree unduly, and also because branch cork grows more slowly than stem cork, the stripping is confined to one portion of the oak at a time.

An implement with a wide sickle-shaped blade is used for removing the cork. The sale unit is the "arroba" (32·38 lbs.). Cork is seldom exported in a raw condition, but is usually cut into strips according to classification; these are steamed and flattened after the defective portions have been removed. The pieces thus prepared are compressed into bales of $59 \times 27{\cdot}5 \times 23{\cdot}6$ inches and bound with iron bands. When bottle corks are made, the sheets are once more steamed and then cut out into cubes; these are trimmed to shape, either by hand with a knife, or by means of a machine. Champagne corks are not manufactured in Portugal.

The wine corks of commerce owe their appearance to being placed in a solution of oxalic acid. When needed for other purposes, they are subjected to other operations. There are no linoleum factories in Portugal, where the cork refuse can be turned to account. The latter is, however, ground and used for floor cement; or is made into insulators.

Amongst the defects that occur in cork, "jaspeada" must be mentioned; this is a dark cloudy discolouration giving a marbled appearance to the cork. Green patches also are to be found caused by a mould, which grows on the unripe cork; other defects are due to the injuries caused by various insects; those due to the attacks of the *Buprestidæ*, *Coræbus undátus*, *Corœbus bifasciatus* and *Agrilus* and which consist of tunnels bored in the cambium layer, are called "colebra." Ants of the genus *Cremastogaster* cause similar damage, while *Tortrix viridana* attacks the leaves and acorns. The best quality of Portuguese cork comes from the districts of Beja, Evora, Portalegre and Algarve.

The annual yield of good dry cork amounts to about 50,000 tons; the total production of cork is 58,192 tons (according to the latest statistics); of this about 11 tons are used in Portugal, while the rest is exported mainly to Germany, Belgium, the United States, Brazil and especially to England. The last country buys the most prepared corks.

The writer gives several tables of the analyses of Portuguese cork, as well as of the acorns of different species of *Quercus* together with their relative nutritive value.—[*The Indian Trade Journal.*]

WIND-BLIGHTED CROPS.

A rather surprising degree of influence of the wind upon plant growth and crops has been shown by the experiments of Dr. Oscar Bernbeck, a German professor of agriculture. Severe gales tended to produce deformity, giving a twisted and knotty shape to twigs; and ordinary winds diminished the energy of growth of sprouts through the increase of transpiration and alteration of circulatory conditions, and had a drying effect that in some cases caused serious injury to both soil and plants. Under a wind of 33 feet per second, the ground lost three or four times as much water as on protected land. On ground sufficiently moist, strong sprouts were but little affected, but on some soils the growth with no wind was three times as great as with a wind of 33 feet per

second. It was evident that the usual moderate wind of Germany—10 to 25 feet per second—may lessen the yield of exposed land more than half. *Protection is to be sought by various kinds* of wind-shields, such as walls and hedges, and especially by planting forests on neighbouring hills.—[*Capital.*]

CLIMATE RECORDS IN TREE GROWTH.

For its study of the growth of living trees the Carnegie Institution of Washington obtains cores from the heart to the bark by means of a special drill. The investigation has included over 300 of the giant trees of California, one of them 3,150 years old, and strong evidence is found of great climatic changes extending over *periods of several centuries. In Arizona, the rings of the western* yellow pine indicate that the climate of the South-Western United States has been long becoming drier, with shortening winters; and this is confirmed by the human ruins now far from water-supplies.—[*Capital.*]

THE STRONGEST TIMBER.

For many years Billian,* a wood that grows in Borneo, was considered the strongest timber in the world, but a new rival has been found in Australia known as Yate.† Its average tensile strength is 24,000 lbs. per square inch, equal to good cast iron. Many specimens are much stronger, one being tested up to 17½ tons per square inch. The tree grows to a maximum height of 100 feet, with a diameter of 2½ to 3 feet. There are many purposes in machine construction, to which such timber might be applied : probably also in the structure of vehicles, and particularly of wooden wheels.—[*Indian Textile Journal.*]

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* Borneo Iron Wood (*Eusideroxylon Zwageri*, T. and B. : Order *Lauraceæ.*)

† *Eucalyptus cornuta*, Labill. : Order *Myrtaceæ.*

RAIN-WATER.

Rain water has been looked upon as typically soft and free from carbonate of lime and other dissolved salts, and it is rather surprising to learn that it may have the hardness of spring-water of limestone regions. This, of course, is a result of the contamination of the air in manufacturing centres. Rain-water collected in reservoirs for an English factory gave so much trouble when used with soap that investigation was made by Dr. S. Wolff, and a report has been made to the Manchester section of the Society of Chemical Industry. The hardening salts found were at first thought to have been taken up from the ground. Samples of rain were collected in basins, however, and all of these contained lime and magnesium salts, all but one having great hardness, which ranged up to 165 degrees of the test scale, or about 58 degrees on the average. As the hardness of the reservoir water was only 19 degrees to 20 degrees, it appeared that the rain actually dropped or deposited some of its hardening salts on reaching the ground.—[*Capital.*]

TIMBER MEASURING TABLES.

In spite of the number and variety of books in existence for calculating the cubical contents of timber, there is room for the two books published by the British Burma Press, under the authorship of Mr. F. A. Leete, Indian Forest Service.

Carter's timber tables (2nd edition) is a new and enlarged edition of the "Tables for computing the Cubical Contents of Round Logs," compiled by the late Mr. P. J. Carter, Indian Forest Service, more than twenty years ago. It speaks well for the contents and arrangement of Mr. Carter's book that it has held the field for so many years. It is time, however, that it was brought more up to date. The old tables left out logs under ten feet in length and stopped at a girth of eleven feet. The expansion of the sleeper trade alone is responsible for a demand for tables for short logs and for logs of extra large girth. The new

edition provides for both of these wants. The largely increased size of the book is chiefly due to the inclusion of decimal tables for converted timber. It remains to be seen whether they will be of much use in the timber trade so long as the old duodecimal system of feet, "inches" and "parts," continues to flourish The author evidently hopes that the publication of these tables will help towards the abolition of this extremely old-fashioned method. But even if this custom still holds its own, the table giving the running feet per ton (50 c.ft.) for all possible sizes of scantling should make the new edition a valuable book of reference in every timber merchant's office. The special table for railway sleepers will also be very useful to any one concerned with this particular branch of the timber trade.

Pocket Timber Tables.—As the name implies this little book is meant for the pocket. It is intended to meet the need forest officers and timber merchants often experience when in the forest or timber depôt of some simple way of getting at the contents of logs without laborious calculations. The author provides two alternative methods. One is a set of tables giving a series of factors to be multiplied into the length to arrive at the volume. The publication of such factors is not new, but these new tables certainly have an advantage over others in letting one know the limits of error involved in the use of the factors. The unique feature of the book is the other method of solving the problem, *viz.*, by the use of diagrams or charts. It is a distinctly novel idea to work three independent factors into a diagram of only two dimensions. The result is certainly very good. The volume of any ordinary log can be read off at a glance with a remarkable degree of accuracy for a chart on such a small scale.—[*Rangoon Gazette.*]

TANNING BY ELECTRICITY.

For sheer cussedness of method and management of her commercial affairs India, in many respects, takes a lot of beating For instance, we produce some of the finest tanning materials the world knows of, so, instead of working them up into tanning extracts and using them for purposes of commercial

development so far as the leather industry is concerned, we export them to foreign countries, who are delighted to do a large amount of our tanning business for us, and to charge us the highest possible price for leather that could have been equally well tanned in this country. Some day perhaps this want of method in doing business will be altered and India will become a huge exporter of leather and leather manufactures. In the meantime, it will probably interest those who have already made a start as tanners in India to know that a method of tanning by electricity has been evolved by Dr. A. Groth, a Swedish Scientist. The hides are put into vats along with metal conductors and are tanned perfectly in less than half the time required by the old method. The process is almost an automatic one, and any defect in a vat is signalled by means of an electric bell. Finally the leather turned out by this new process is said to be of finer quality than can be produced by the old style. Now who is going to be the first electric tanner in India ?—[*Capital.*]

THE INJURY FROM SMOKE.

The injury to plants and animals by the great deposits of soot washed down from the air of factory towns has been traced by Dr. R. C. Benner, chiefly to the tar and free acid, both of which are corrosive, while the adhesiveness of the tar prevents plant transpiration. Tree rings in a Scotch fir diminished at once after the erection of a factory near, and vegetables in smoky towns showed reduced growth. Lessened sunlight and increased fog are injurious atmospheric conditions.

FERTILIZING AGAINST FROST.

Potash fertilizer seems to give protection from frost. W. Golte, in France, has found that plants in a field strongly fertilized with kainite suffered little from a series of heavy frosts, those on a lightly fertilized area were more injured, and those on untreated land were much damaged.—[*Capital.*]

WOOD SUGAR.

The making of grain or ethyl alcohol from sawdust has been so restricted in England by absurd regulations that the industry is seriously crippled. Classen's process made use of the fact that sawdust digested with a weak solution of sulphurous acid under six or seven atmospheres pressure is converted into sugars with a yield of about twenty-five per cent. Four-fifths of this can be fermented into alcohol if desired, but now the English are extracting this crude wood sugar and using it as stock food. It cannot be crystallized for commercial table use.

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SOME NOTES ON THE *TAUNGYA* PROBLEM IN THE SHAN STATES.—(*concluded.*)

THE FUTURE OF TAUNGYA AND SOME SUGGESTIONS ON A TAUNGYA POLICY.

It is a dangerous step to suggest lines for action in respect of taungya after the reams written by "the devout and learned who rose before us and as prophets burned," but after reading most of what has been written, what is the essence of it all? That something ought to be done. What has been done? Various reserves have been taken up and a certain amount of research into the soils of taungya has been made with inconclusive results owing to lack of funds to keep the experiments up. Further it has been "hoped that District and Forest Officers will use every effort to impress upon the ya-cutters the greater value of permanent as opposed to shifting cultivation." (I quote from memory.)

In the end everything seems to be much where it was.

Short of saying "leave it alone," there seem to be only two ways of tackling the problem: either to go for the more or less

rapid abolition of taungya or to allow its continuance while trying to make it as productive and as little destructive as possible.

Total abolition by a mere stroke of the pen is obviously out of the question. It can only be brought about by gradually increasing the number of reserves on a giant scale or by extending the operation of rules prohibiting taungya cutting.

A policy of total abolition however leaves out of account altogether the question of what is to replace taungya in its position as a substitute for or a supplement to wet or other permanent cultivation. It has been proposed in the case of some of the semi-nomadic tribes to adopt the mediæval process of "decanting" the population summarily to some other part. This is in keeping with the views of some who look on the ya-cutter as a pirate, a wolfshead and an enemy of the human race, but apart from the feelings of those about to be decanted, it hardly takes into consideration the feelings of the chief whose revenue is to drop considerably on their departure. Nor does it say what is to happen to them at their destination if in the Shan States.

Judging from the mediæval chronicles, the process of decanting is not likely to endear the Forest Department to the tribes who do not look any too favourably on it now.

Turning to reservation on a large scale, including the application of prohibitory rules without reservation, the problem is no nearer solution. One seems obliged to realise now that in the Shan States reservation means depopulation. Villages start shifting the moment a reserve is mooted. In spite of the villagers' assurances that their claims have been fully satisfied the people start drifting away, not necessarily in a body but none the less surely. Whether they will ever return is at present uncertain, but the prospect is not encouraging. The ya-cutter's views might probably be expressed as "You make a wilderness and call it a reserve"; and we must confess that there is some truth in the sentence, for to him at least the whole business must appear perfectly incomprehensible.

We sometimes take up hundreds of square miles at a tim containing little teak and less of anything else valuable, make him worry out how many house-posts, bamboos and thatch he wants in a year, where he wants to shoot monkeys and catch frogs and then we go away and never come near the place or do anything with it more than we did before it became a reserve.

Probably his actual requirements were liberally satisfied, but undoubtedly what the ya-cutter feels is that he is no longer free to do what he wants, that he is ringed in and that Government is playing dog-in-the-manger to him. So he moves off to start again on a new piece of forest and to help shorten the rotation on another taungya area.

Doubtless reservation in this wise would finally abolish taungya throughout the country, but would also abolish three-quarters of the population and in the meantime have led to the complete destruction of the last remaining bits of forest in the country long before all the reserves were finally taken up.

THE POSSIBLE REGULATION OF TAUNGYA METHODS.

The alternative to looking on taungya as a monstrosity to be got rid of at once is to accept it as part of the natural agriculture of the country and do the best for it we can. In making the following suggestions I would merely try and indicate the directions which any efforts to improve taungya might take and I leave out of consideration taungya of type I, which is not very prevalent in the Shan States. No amount of argument will convince these primitive tribesmen that their methods are capable of improvement. To them their methods are the best, or if they aren't at any rate they suit them best. Failing argument, compulsion can hardly be applied to a man whose whole realisable property consists of a dah, a cross-bow and the clothes he stands up in. He can only be given the alternatives of falling in with our views on the way to cut taungya or of taking himself off to some less benighted country, as indeed he seems to be doing at this moment. There is however a vast difference between this and decanting the population willy nilly.

As regards other types, it is plain that our efforts must be directed to arriving at a method by which there shall always be sufficient vegetation on the ponzos to bring about a constant succession of crops of the best quality that can be obtained from the soil and the climate, in other words, to prevent the progressive deterioration of the ponzo growth. By doing this we shall also put to rest many of the fears about erosion and water-supply to the plains, for few I think will be found to deny that a thick ponzo growth, if not as good a soil—and water—retainer as high forest, is at least a very good substitute.

The factors which lead to progressive deterioration of the ponzo growth are—(1) shortening the rotation, (2) firing the ponzos, (3) heavy grazing, (4) heavy fuel cutting.

Of these the first is the hardest to deal with because it is least apparent on the surface and is a direct result of the chief aim of good government, namely, a steady increase in the population. Up to the present wet cultivation has not kept pace with the relatively small natural increase in the population and is still less likely to when immigration is added to natural increase. It is not for me to trespass on other departments' spheres of work and suggest how wet cultivation is to be expanded, but one may be allowed to observe that phrases like the above quoted "It is hoped, etc.," have in themselves no mystic power which stir thousands of Shans to dig fields and irrigation channels any more than they will summon legions of "nats" to do the business for us in a single night.

Extension of wet cultivation means outlay of capital and the question is, who is going to spend the money? It is evident that enough money for the creation of a large area of fields will not be forthcoming among the Shans themselves.

I mentioned before the two main reasons which influence the Shans against rapidly extending wet cultivation, apart from merely tribal or sentimental reasons such as a preference for hill rice which also carries weight among some tribes. If the objection to investing his labour in making fields hinder their extension on the relatively level plateau land, how much more will this be the

case in the narrow valleys where the making of each field entails the moving of an enormous amount of earth ? Starting from a terrace 3 feet wide, which is about the smallest I have seen, a very simple calculation will show the large amount of excavation needed for each square foot of width gained on a very moderate slope. In addition the presence of a suitable supply of water is a *sine quâ non* which is by no means universally found.

Leaving the broken country, what is to be done with the open plateau and plain lands such as are found in Hsum Hsai, Lawksawk and much of the Teng basin, where conditions are not as favourable to open dry cultivation as in the Myelat ? Here wet cultivation is faced with the difficulty of raising water from a water-table 20—30 ft. below the average surface level. Although I personally believe strongly in the future of mechanical well irrigation in these parts, I do not think that we can expect the inhabitants to find the necessary capital. The other means for improving the return from the soil, which have been suggested, such as more intensive and concentrated cultivation or the adoption of special methods of dry cultivation on American lines, will, when generally adopted, be of immense benefit to the country. The process of adoption must inevitably take many years and in this interval the taungya problem will be as acute and unsolved as ever.

(2) *Fire.*—While the prospects of keeping the rotation up by getting more fields made are not particularly good, there is an indirect way of helping in this matter by fire-protecting the ponzos. Firing the ponzos is indirectly the surest way of bringing the rotation to its minimum. Without careful and prolonged experiments it is impossible to give exact figures ; my own impression is that equal numerical rotations in protected and unprotected ponzos stand in the relation of 3 : 1 as far as ponzo growth is concerned, possibly 3 : 2 for rotations of over 15 years. We are so accustomed to seeing unreserved forest, whether ponzo or not, burnt every year that the average man has no chance of realising the results of protection on ponzo land. The most striking contrast may be seen when going up the Loikaw-Yado trade route on

leaving the Padaung country and entering Karenni proper. The treelessness and general arid appearance of the country just inside the Karenni border strikes the traveller most forcibly compared with the thick if stunted growth on the Padaung ponzos just left behind. Although this aridity is due to a combination of all the destructive factors previously mentioned, fire is undoubtedly the one which has done most of the damage. Among the Padaung we are told that firing the ponzos is ranked with the robbing of graves as the worst of crimes, and with some justice, for robbing the graves is but robbing the dead while firing the ponzos is robbing the living and those to come. The Padaungs in former and more enlightened days found an excellent remedy for the mental disease of incendiarism; they treated this distressing and almost universal complaint with an injection of metallic lead. This was found to be most effective in preventing a second attack in the patient and further produced a permanent immunity from infection amongst his friends and neighbours.

In spite of the controversy about fire-protection in teak reserves, there is no general contention against protection in areas under coppice regeneration or in plantations, under both of which headings ponzo land can be included. It must be a matter of some surprise to an outside observer that while lakhs of money are spent yearly in protecting forests which have grown up in spite of fires and which from their sylvicultural system make little demands upon the soil, those areas in which there is a heavy demand upon the soil in every way are left entirely unprotected.

Fire-protection is at once the least expensive and most important step which can be taken on the road towards regulating and improving taungya. If undertaken boldly there is no reason why it should not become effective within ten years. But for this it must be applied universally and the villages made collectively responsible for its carrying out. If not made universal in the Shan States, at least in the Cis-Salween portion, it will defeat its own ends. Partial enforcement will simply mean emigration from the protected to the nearest unprotected areas with the inevitable overcrowding and overworking of the latter. We have already

had an example of this in the case of the Zawgyi reserve in the Southern Shan States, where the Padaung in their enclaves in the reserve are made to protect their ponzos. The result has been a steady migration to the unprotected Padaung settlements in the Loi Sang hills where the pressure on the taungya lands is now becoming serious. Failure to enforce it universally will at once give a double sense of grievance to those living in the protected areas. Almost equally important in the placing of collective responsibility on the villages; any attempt to bring the guilt home to the actual offender in each case will make the system a farce. Every Forest Officer who has had charge of protected reserves knows how almost impossible it is to detect an individual offender and when starting protection over village ponzos it will be quite impossible. Moreover, it is not as if the principle of collective responsibility were completely new to the Shan States, it is on the contrary well established there in other matters such as track law. The introduction of fire-protection generally will inevitably be met with considerable resentment and opposition on the part of the villagers. At first we shall have to expect evasion in every form, but if only a firm stand is taken up at the start and the villagers made to understand that no nonsense is to be allowed, we shall find within a very reasonable time that fire-protection has become a regular recognised part of the ya-cutter's procedure. If a small tribe like the Padaung, whose country is intersected by two important trade routes and surrounded by unprotected country, have been able to protect their ponzos year after year, it is surely not expecting too much to attempt to bring protection over the rest of the Shan States even without resorting to the former drastic measures of the Padaung.

(3) *Grazing*.—The question of grazing is not so serious as the two preceding, but in view of the steady opening up of and immigration into the Shan States along the railways, it deserves attention. The grazing of cattle owned by the ya-cutters or established permanent cultivators is not heavy enough for its effect to be noticeable. Nor do the pack cattle of the caravans in the off season make much difference, except that forest

which might otherwise escape is deliberately fired to get young grass.

The grave danger is the grazing of the cattle owned by immigrants from India. It will of course be said that the bulk of the immigrants live in the large stations where the grazing can be regulated, but the experience gained from Maymyo shows clearly that regulation within the limits of a station, however large does not entirely meet the case. The cattle in immediate use are grazed inside the regulated limits, but as this means paying license fees, the big owner sends his main herd outside the limits and keeps them there. Thus herds of 100 to 200 head of cattle graze down everything within a narrow but gradually widening radius and we look on complacently at the spectacle of the foreigner, who contributes little or nothing to the revenue of the country, enriching himself at the expense of the forest and of the original population whose cattle are crowded out.

These large herds, which are increasing yearly, benefit no one but the owner, as there are always far more than are needed for the meat and milk supply of the place, nor do they serve for transport for which they are rarely broken in. The grazing question also concerns reserves in the neighbourhood of civil stations, and it is to be hoped that those responsible for the new stations of Kalaw and Myindaik in the Southern Shan States will be wise in time with measures to prevent matters getting into the same state that they are in Maymyo at present.

(4) *Fuel cutting.*—This is of minor importance in the remoter taungya villages of small size. When however the villages are permanent and large, one regularly notices that the nearest ponzos are considerably thinner than those further off. This is mainly due to fuel cutting and its effect is unfortunately cumulative, as often when these yas come to be cut there is not enough growth left on them to burn the soil properly and the neighbouring ponzos are called upon to supply the want. Unhappily, too, ponzo growth affords just the right size of wood for domestic use both as fuel and fencing. Even when some of the trees are left standing when the ya is cut, as in parts of Lawksawk, Hsipaw and

Hsenwi, and more than enough to supply the village for several years may be seen all round, the fuel used in the village will be found to be small billets obviously taken from ponzo of six to seven years old. In this connection, when fuel reserves and their working-plans are being considered, it is, I think, worth noting the point that large fuel is not wanted by the native population and will probably not be bought if small fuel can be got even with greater difficulty or at a somewhat higher price. For the larger centres some modification of the present rules may meet the case while the remoter villages will have to wait till we get some sort of taungya settlement established.

FINAL SUGGESTIONS.

Assuming that it is decided to allow taungya to continue as one of the recognised agricultural systems of the country under proper regulation and systematisation, what steps can be taken towards bringing this about? The first and easiest step is to bring in fire-protection simultaneously and universally over the Cis-Salween Shan States. It is a step which should commend itself to Government as it would entail little or no expense if introduced on the lines indicated above. Alone it is not sufficient. No measures, however sweeping and drastic, can ultimately prevent the steady deterioration of the ponzos unless the extension of wet or other intensive cultivation proceeds hand in hand with these measures. As above mentioned, it is certain that such cultivation will not extend with the necessary rapidity without encouragement. Such encouragement needs to be of an active and practical form, for which passive applause and pious expressions of good-will are no substitute. In addition some sort of a taungya settlement or working-plan is wanted. We need to know a great deal more about taungya methods, taungya rotations, taungya crops and the acreage of ya required per household than we do at present. Too much of the information which has been collected up to now on taungya cutting in general is just the boiling down of odd scraps of observations noted under widely differing conditions by a host of officers looking at the subject from widely different

points of view. Or else it has been the regular formal report by the head of the district, who boiled down the reports of the S. D. O.'s, who boiled down the reports of the myooks, who repeated the reports of the circle headmen, who gave their idea of what the village headmen ought to have said, who said as little as they could; and the result is "piper's news" to us all.

We need a much more individual and direct enquiry and report. In a little known subject such as this, the advantage of being able to repeat the same observations on different methods of taungya and to compare and complete conclusions made in one in some other part of the country, far outweighs the advantage of having the conclusions of several equally competent observers without personal experience of the conditions in parts other than their own immediate field of work. The collection of data would require a special officer for several seasons in either part of the Shan States alone. The ordinary civil and forest officers have not the time to carry out a proper enquiry in conjunction with their ordinary work; nor is the nature of the work attractive to all and sundry even were the time forthcoming. Long days on foot, side trips to inaccessible villages with only coolie transport and a minimum of kit, camps in drafty "tes" on windy spurs or in a native hut with a rich local fauna, a strong seasoning of native liquor to one's whisky, soup and tea from the double duty served by the village water-pots, are not likely to encourage officers to examine taungya areas when there is plenty of other work to be done elsewhere in more comfortable circumstances.

The information to be collected would include an estimate of the area of the taungya lands belonging to each village or group, its proportion to the population, the length of the rotation, the quality of the ponzo growth with its chief species, notes on the land available for wet cultivation, grazing and fuel needs and on the growth and migration of the population.

By the above notes on the taungya problem I have tried to show how the country is losing the full value of the land both by leaving the problem alone and by the incomplete measures taken hitherto, but I hope to have indicated roughly the lines on which

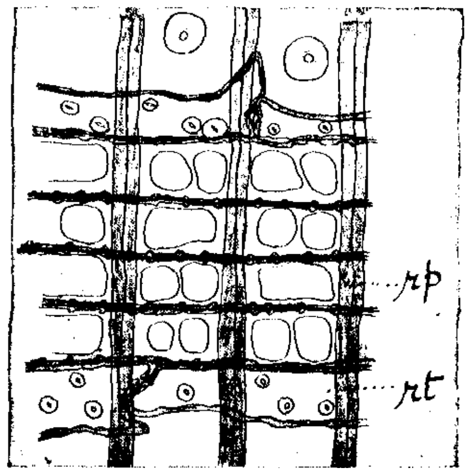

FIG. I. PINUS EXCELSA.
(Blue Pine).

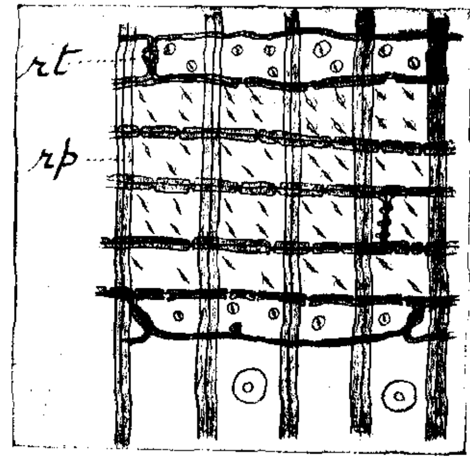

FIG. 2. PINUS GERARDIANA.
(Himalayan Edible Pine).

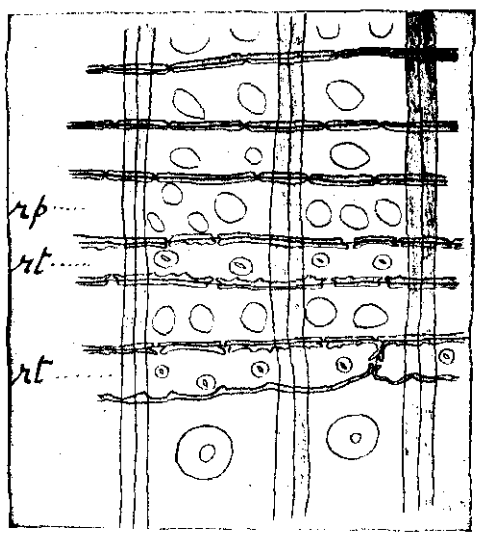

FIG. 3. PINUS LONGIFOLIA.
(Chir Pine).

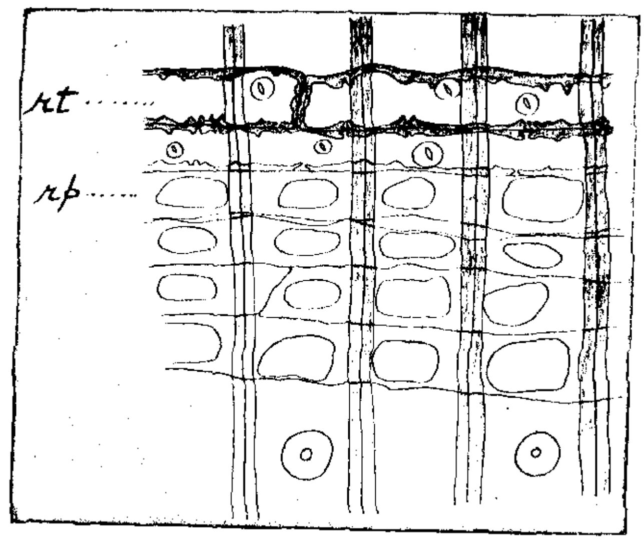

FIG. 4. PINUS KHASIA.
(Khasia Pine).

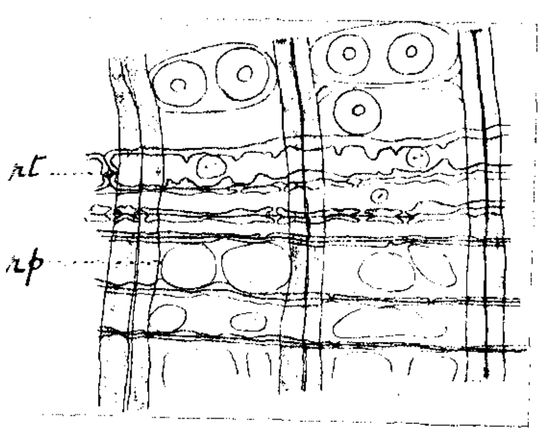

FIG. 5. PINUS MERKUSII.

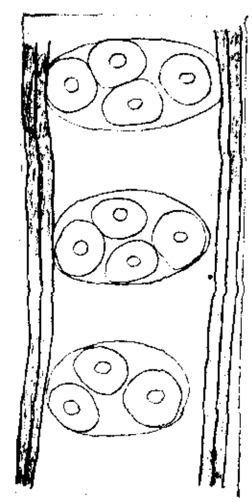

FIG. 6. PINUS MERKUSII.

THE INDIAN SPECIES OF PINUS.

some improvement might be made. I have made no reference to the question of artificially restocking ponzos with quick growing species, such as *Alnus nepalensis*, nor to the possible use of green manures. These have already been dealt with by abler pens than mine and their suitability to the climate and conditions of the Shan States can only be decided by careful trial on the spot. Their trial should form part of any serious attempt to improve taungya methods.

It is too much to expect that the views and suggestions expressed in these notes will commend themselves to the majority of foresters or other officials in Burma, but if only they lead to a reconsideration of the present situation and hasten the start of some definite policy in connection with taungya in the Shan States they will have served their purpose.

TAO HAI.

CRITICAL IDENTIFICATION OF THE WOOD OF INDIAN PINES.

(*vide* PLATE 9).

An investigation of the structure of the wood of the five Indian species of *Pinus* has recently been completed by Mr. W. Rushton and myself. Our joint paper communicated to the Linnean Society contains much that will not be of interest to foresters, yet it does not give a scheme for distinguishing these different timbers from each other. Absolute proof of the identity of any of these timbers is possible only by means of microscopic examination, by the aid of which, moreover, the wood can be recognised after it has been creosoted or stained. To facilitate such identification I have drawn up the appended Table, which is preceded by some explanatory remarks.

In the wood of *Pinus*, in addition to the tracheides running along the length of the stem and constituting the main mass of the wood, there are others in the medullary rays that are directed radially. In the sequel the former are termed simply " tracheides and the latter " ray-tracheides."

In one great section of the genus *Pinus* the outermost one or more layers of tracheides in each annual ring invariably bear numerous bordered pits on the outer and inner (" tangential ") walls. Moreover, in the same section the ray-tracheides have no tooth-like processes (" denticulations ") projecting inwards from their walls (Figs. 1 and 2, *rt.*), or at most possess only scanty and feeble denticulations. When viewed with the naked eye the transition of the spring-wood to summer-wood (so-called "autumn-wood ") is gradual. *Pinus excelsa* and *Pinus Gerardiana* belong to this section.

The wood of the other great section of *Pinus* shows the following characters. The outer layers of tracheides in the annual ring are generally devoid of pits on their tangential walls, though here and there in some specimens occasional tracheides may possess such tangential pits. The ray-tracheides have " denticulations " on their walls (Figs. 4 and 5, *rt.*). When viewed with the naked eye the transition from the spring-wood to the summer-wood is usually sudden (*P. Khasya* at least sometimes provides an exception to this rule). *P. longifolia*, *P. Khasya* and *P. Merkusii* belong to this section.

It is therefore easy to distinguish the woods of the two first-mentioned species from those of the last three.

The arrangement of the bordered pits on the radial walls of the tracheides varies in the different species. These pits may be " uniseriate," that is arranged in a single row along the wall (Figs. 1—4) ; or they may be " biseriate," in which case there are two rows of pits along the wall, the pits being arranged side by side in pairs (Fig. 5) ; similarly the pits are " triseriate " with the pits arranged in three's side by side. This last arrangement is so far known in only one conifer in the world—*Pinus Merkusii*, in which the pits on the radial walls of some spring-tracheides show another absolutely unique arrangement, namely, in " nests " of threes or fours (Fig. 6). Sometimes in the uniseriate types the single row is interrupted by a single pair of pits side by side, and this arrangement is described as " paired." In all investigated pines the arrangement of the pits in the radial

walls of at least the outer summer-tracheides in each annual ring is uniseriate. The differences as regard this pitting therefore solely concern the spring-wood. In one and the same annual ring the arrangement of the pits may differ in different spring-tracheides, so that it may be uniseriate in one tracheide, and biseriate in another. In the latter case the arrangement would be described as 1—2 seriate.

Other structural features of import in identifying the different pine-timbers concern the walls of the parenchyma-cells ("ray-parenchyma") of the medullary rays. In the first place these walls may be thick or thin. In the second place the pits on the radial walls differ in size, shape, and number in the different species. The pits in question may be so considerable in size that each stretches nearly completely across the wall, that is, its diameter approaches the height of the cell so that only one tier of pits is possible on the radial wall of the cell (Figs. 1, 4, 5, *rp.*), or these pits may be so small that there can be several tiers up the radial side of the cell (Fig. 2, *rp.*). In further defining the size and number of these pits it is necessary to have some definite area for measurement, and the area most convenient to employ for this purpose is the area covered by the whole height of the cell and by that length of it that corresponds to the radial width of one tracheide which it crosses.

TABLE.

Outer summer-tracheides always having pits on the tangential walls. Ray-tracheides not "denticulate." Pits on the radial walls of the spring-tracheides uniseriate, or occasionally paired, never biseriate.	Pits on the radial walls of the ray-parenchyma apparently simple, large, often nearly equal to the height of the cell, often only *one* to the radiai width of a tracheide (Fig. 1).		*P. excelsa* (Blue Pine).
	Pits on the radial walls of the ray-parenchyma clearly bordered, small, not nearly equal to the height of the cell, 2—5 to the radial width of one tracheide (Fig. 2).		*P. Gerardiana* (Himalayan Edible Pine).
Outer summer-tracheides generally devoid of pits on their tangential walls. Ray-tracheides "denticulate." Some of the spring-tracheides have biseriate pits on the radial walls.	Pits on the radial walls of the spring-tracheides 1—2 seriate, never 3-seriate.	Ray-parenchyma mostly thick-walled, with pits on the radial walls not nearly equalling the height of the cell but often in two tiers (Fig. 3).	*P. longifolia* (Chir Pine).
		Ray-parenchyma nearly entirely thin-walled, with pits on the radial walls often approaching the height of the cell (Fig. 4).	*P. Khasya* (Khasia Pine).
	Pits on the radial walls of the spring-tracheides 1—3 seriate or arranged in "nests" of 3's or 4's (Figs. 5, 6).	...	*P. Merkusii.*

It is evident that the woods of *P. excelsa*, *P. Gerardiana*, and *P. Merkusii* can be easily recognised by their microscopical structure.

The woods of *P. longifolia* and *P. Khasya* require rather closer attention to details, and in order to facilitate their identification the following additional particulars are given with the proviso that future investigation alone can decide to what extent the characters about to be enumerated are invariable and characteristic of the species. In *Pinus longifolia* the resin-ducts are solitary or in pairs, but are extraordinarily wide, up to 0·2 mm. in diameter; those of *P. Khasya* are clustered in groups of two, three, four, or even more, and, although rather wide, their maximum diameter does not exceed ·08 mm. The normal wood of *P. Khasya* (like that of *P. Merkusii*) is here and there traversed by radial bundles or bands of tracheides that have radially deflected and bent ends and possess bordered pits on all their walls. Finally the tallest medullary rays of *Pinus longifolia* (up to 30 cells in height) are much higher than those of *Pinus Khasya* (up to 20 cells high).

The figures are all of radial longitudinal sections and were drawn by Mr. Rushton. The magnification is 312 diameters: *rp* = ray—parenchyma, *rt* = ray—tracheide.

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NEW INDIAN SPECIES OF FOREST IMPORTANCE.

Indian Trees, which was published by Sir Dietrich Brandis in 1906, provides Indian Forest Officers with a most valuable comprehensive enumeration of their important forest species. In Botany, however, as in other Sciences, knowledge is constantly progressing and a number of new species are annually described which are of importance to the Indian Forest Officer. If we wish to keep up to date, therefore, it is essential that a careful record of all species new to science or new to India and which are not

included in *Indian Trees* should be maintained. Such a record has accordingly been commenced in the Herbarium of the Forest Research Institute, Dehra Dun, where it will facilitate the correct identification of specimens by the Forest Botanist, and where it will be available for reference for the authors of Descriptive Lists (or Local Forest Floras) and others who may work in the Dehra Dun Herbarium. The new species are entered in a card-index catalogue, and it is proposed to publish a list of them in the *Indian Forester* at the close of each calendar year for general information. The first of these lists is given below. It includes the Indian Trees, Shrubs, strong Climbers and Bamboos, which are not included in Brandis' *Indian Trees* and which have been published up to the year 1912 inclusive.

The present List lays no claim to completeness, and it is hoped that readers of the *Indian Forester* will draw attention to any omissions or errors which they may detect, so that these may be rectified in subsequent lists. Arrangements have now been made for the regular supply to the Dehra Herbarium Library of the chief periodicals in which descriptions of Indian species are usually published, so that it should be possible to make future lists practically complete.

LIST NO. 1 (*to* 1912 *inclusive*).

Acer Osmastoni, Gamble. (Kew Bull., 1908, p. 446), Darjeeling.

Adenosacme chasalioides, Craib. (Kew Bull., 1911, p. 190), Burma.

Albizzia Lathamii, Hole. (Ind. For. Rec. IV. 4, p. 153), Madras.

Allophylus subfalcatus, Radlk. (Rec. Bot.-Sur., Ind. III, p. 342), Assam and Bengal.

5. **Antidesma Collettii,** Craib. (Kew Bull., 1911, p. 461), Burma,

Aristolochia punjabensis, Lace. (Kew Bull., 1911, p 273), Punjab.

Aristolochia Hookeriana, Craib. (Kew Bull., 1911, p. 450), Burma.

Arundinaria Maling, Gamble. (Kew Bull., 1912, p. 139), Sikkim.

Beaumontia brevituba, MacGregor and Smith. (Rec. Bot. Sur., Ind., IV, p. 278), Burma.

10. **Beilschmiedia Robertsoni,** Gamble. (Kew Bull., 1912, p. 200), Burma.

Berberis Parkeriana, C. K. Schn. (Fedde Rep. Sp., Nov. 1912), Punjab.

Boschia Mansoni, Gamble. (Kew Bull., 1908, p. 445), Burma.

Butea pellita, Hook f. (Kew Bull., 1908, p. 386), Kumaon, Naini Tal.

Calamus Delessertianus, Becc. (Ann. Calc. XI, p. 276), S. India.

15. **C. Hookerianus,** Becc. (Ann. Calc. XI, p. 226), Coromandel.

C. Khasianus, Becc. (Ann. Calc. XI, p. 431), Assam.

C. Kingianus, Becc. (Ann. Calc. XI, p. 197), Assam.

C. leucotes, Becc. (Ann. Calc. XI, p. 309), Burma.

C. Metzianus, Schlecht. (Ann. Calc. XI, p. 221), Kanara.

20. **C. nambariensis,** Becc. (Ann. Calc. XI, p. 433), Assam.

C. polydesmus, Becc. (Ann. Calc. XI, p. 430), Burma.

Cedrela Hainesii, C. DC. (Rec. Bot. Sur., Ind., III., p. 363), Singhbhum.

Cedrela Kingii, C. DC. (Rec. Bot. Sur., Ind., III., p. 371), Sikkim.

Cedrela longifolia, Wall. (Rec. Bot. Sur., Ind., III., p. 375), Kumaon.

25. **Cedrela Mannii,** C. DC. (Rec. Bot. Sur., Ind., III, p. 374), Assam.

Cereus pterogonus, Lemaire. (Rec. Bot. Sur., Ind., IV, p. 294), Bengal, Burma.

Clematis zemuensis, W. W. Smith. (Rec. Bot. Sur., Ind., IV, p. 166), Sikkim.

Cornus controversa, Hemsl. (Kew Bull., 1909, p. 331), Sikkim, Assam.

Cornus Stracheyi, Hemsl. (Kew Bull., 1909, p. 333), Kumaon.

30. **Craibiodendron shanicum,** W. W. Smith. (Rec. Bot. Sur., Ind., IV, p. 277), Burma.

Cynometra Bourdilloni, Gamble. (Kew Bull., 1908, p. 446), Travancore.

Dalbergia Lacei, Prain. (Kew Bull. 1907, p. 58), Burma.

Dalbergia maymyensis, Craib. (Kew Bull., 1912, p. 390), Burma.

Decaschistia rufa, Craib. (Kew Bull., 1912, p. 35), Madras.

35. **Dillenia Kerrii,** Craib. (Kew Bull., 1911, p. 8), Burma.

Dioscorea Daunaea, Prain and Burkill. (Journ. As. Soc., Beng., 1908, p. 450), Burma.

Dioscorea Listeri, Prain and Burkill. (Journ. As. Soc. Beng., 1908, p. 452), Assam.

Dioscorea melanophyma, Prain and Burkill. (Journ. As. Soc., Beng., 1908, p. 453, N.-W. Himalayas).

Dioscorea Wattii, Prain and Burkill. (Journ. As. Soc., Beng., 1908, p. 457), Assam, Bengal.

40. **Elæocarpus Robertsoni,** Gamble. (Kew Bull., 1912, p. 199), Burma.

Euonymus scandens, R. Graham. (Kew Bull., 1908, p. 33), Nepal.

Euphorbia Lacei, Craib. (Kew Bull., 1911, p. 456), Burma.

Garuga Gamblei, King. (Rec. Bot. Sur., Ind., IV., p. 262), Sikkim.

Grewia Lacei, Drummond and Craib. (Kew Bull., 1911, p. 21), Burma.

45. **Gymnema Griffithii,** Craib. (Kew Bull., 1911, p. 416), Burma.

Gymnema Lacei, Craib. (Kew Bull., 1911, p. 191), Burma.

Hedera himalaica, Tobler. (Die Gattung Hedera, 1912), Himalayas.

Hedyotis sisaparensis, Gage. (Journ. As. Soc., Beng., 1905, p. 244), Madras.

Hibiscus Watsoni, W. W. Smith. (Kew Bull., 1912, p. 198), Burma.

50. **Illigera trifoliata,** Dunn. (Journ. Linn. Soc., 38, p. 294), Assam, Burma.

Indigofera Lacei, Craib. (Kew Bull., 1910, p. 382), Burma.

Irvingia Oliveri, Pierre. (Rec. Bot. Sur., Ind., IV, p. 276), Burma.

Lagerstrœmia Collettii, Craib. (Kew Bull., 1911, p. 53), Burma.

Lepisanthes assamica, Radlk. (Rec. Bot. Sur., III, p. 343), Assam.

55. **L. basicardia,** Radlk. (Rec. Bot. Sur., III, p. 345), Burma.

L. granulata, Radlk. (Rec. Bot. Sur., III, p. 344), Burma.

L. Listeri, King. (Rec. Bot. Sur., III, p. 344), Assam.

Lespedeza sessilifolia, Gamble. (Kew Bull., 1912, p. 199), Burma.

Manglietia Hookeri, Cubitt and Smith. (Rec. Bot. Sur., Ind., IV, p. 273), Burma.

60. **Melodorum minuticalyx,** MacGregor and Smith. (Rec. Bot. Sur., Ind., IV, p. 274), Burma.

Millettia Cubitti, Dunn. (Journ. Linn. Soc., XLI, p. 188), Burma.

Millettia eriocalyx, Dunn. (Journ. Linn. Soc., XLI, p. 150), Burma.

Millettia Griffithii, Dunn. (Journ. Linn. Soc., XLI, p. 146), Burma.

Millettia podocarpa, Dunn. (Journ. Linn. Soc., XLI, p. 166), Burma.

65. **M. Prainii,** Dunn. (Journ. Linn. Soc., XLI, p. 174), Sikkim.

M. trifoliata, Dunn. (Journ. Linn. Soc., XLI, p. 165), Burma.

Mussænda Treutleri, Stapf. (Bot. Mag. V. t. 8254), Sikkim, Assam.

Myxopyrum serratulum, A. W. Hill. (Kew Bull., 1910, p. 41), Travancore, S. India.

Nyctocalos shanica, MacGregor and Smith. (Rec. Bot. Sur., Ind., IV., p. 280), Burma.

70. **Opuntia cochinelifera,** Mill. (Rec. Bot. Sur., Ind., IV, p. 292), India and Burma.

Opuntia elatior, Mill. (Rec. Bot. Sur., Ind., IV, p. 293), throughout India.

Opuntia monacantha, Haw. (Rec. Bot. Sur., Ind., IV, p. 292), India and Burma.

Opuntia nigricans, Haw. (Rec. Bot. Sur. Ind., IV, p. 293), Bengal.

Oritrephes septentrionalis, W. W. Smith. (Journ. As. Soc., Beng., 1911, p. 69), Burma.

75. **Osbeckia Hildebrandii,** Stapf. (Kew Bull., 1911, p. 269), Burma.

Osbeckia racemosa, Craib. (Kew Bull., 1911, p. 51), Burma.

Oxytenanthera Lacei, Gamble. (Kew Bull.' 1910, p. 385), Burma.

Do. Do. Do. (Kew Bull., 1911, p. 192), Burma.

Paradombeya multiflora, Gamble. (Kew Bull., 1912, p. 198), Burma.

80. **Paranephelium hystrix,** W. W. Smith. (Rec. Bot. Sur., IV, p. 275), Burma.

Pentapterygium sikkimense, W. W. Smith. (Rec. Bot. Sur. IV, p. 268), Sikkim.

Piper longicaule, C. DC. (Rec. Bot. Sur., Ind., IV, p. 11), Madras.

Pittosporopsis Kerrii, Craib. (Kew Bull., 1911, p. 28), Burma.

Pogostemon hispidus, Prain. (Kew Bull., 1908, p. 254), Assam, Burma.

85. **Prunus macrophyllus,** Sieb and Zucc. (Rec. Bot. Sur. Ind., IV, p. 276), Burma.

Pueraria alopecuroides, Craib. (Kew Bull., 1910, p. 276), Burma.

Sambucus Wightiana, Wall. (Kew Bull., 1909, p. 192), Punjab.

Stereospermum grandiflorum, Cubitt and Smith. (Rec. Bot. Sur., Ind., IV, p. 280), Burma.

Strobilanthes Meeboldii, Craib. (Kew Bull., 1910, p. 278), Bombay, Mysore.

90. **Styrax Lacei,** W. W. Smith. (Kew Bull., 1911, p. 344), Burma.

Terminalia tripteroides, Craib. (Kew Bull., 1912, p. 152), Burma.

Uraria Lacei, Craib. (Kew Bull., 1910, p. 276), Burma, Assam.

Vernonia comorinensis, W.W. Smith. (Rec. Bot. Sur., Ind., IV, p. 283), Madras.

Vernonia Dalzelliana, Drummond and Hutchinson. (Kew Bull., 1909, p. 261), Bombay.

95. **Wormia Mansoni,** Gage. (Journ. As. Soc., Beng., 1906, p. 73), Burma.

Wrightia sikkimensis, Gamble. (Kew Bull., 1908, p. 447), Bengal.

Xerospermum intermedium, Radlk. (Rec. Sur., Ind., III, 349), Burma.

Xylia Kerrii, Craib and Hutchinson. (Kew Bull., 1909, p. 357), Burma.

R. S. HOLE, I. F. S.

ON INDIAN OAK BARKS AS MATERIALS FOR THE MANUFACTURE OF TANNIN EXTRACTS.

In Europe Oak barks are considered to be the best tanning materials and they command higher prices than do the other tanning materials available in Europe. The European Oak barks are said to contain 8—13 per cent. of tannin.

The Indian Oak barks compare very favourably with those of the European species. Prof. H. Trimble was the first to

examine the Indian Oak barks in 1894 with the following results :—

	Moisture.	Tannin.	Tannin on dry.
Quercus glauca, Thunb.	6·85	11·37	12·20
,, *dilatata*, Lindl.	6·81	7·40	7·64
,, *incana*, Roxb.	5·31	22·12	23·36
,, *semecarpifolia*, Sm.	7·04	7·99	8·60

Last year the Forest Chemist examined 8 samples of Indian Oak barks obtained from different localities with the following results :—

No.	Description of the sample.	Locality.	Moisture %.	Soluble solids %.	Non-tannin %.	Tannin %.	Tannin on dry material %.
1	*Quercus incana* ...	Chakrata ...	43·35	11·89	5·36	6·53	11·52
2	,, ,, ...	Naini Tal ...	20·94	17·50	6·98	10·52	13·28
3	,, *dilatata* ...	Chakrata ...	34·13	8·59	4·63	3·96	6·01
4	,, *lineata* ...	Darjeeling ...	43·00	14·27	5·24	9·03	15·84
5	,, *pachyphylla* ...	Do. ...	53·36	16·08	5·56	10·52	22·44
6	,, *semecarpifolia* ...	Chakrata ...	34·62	8·36	4·63	3·73	5·53
7	,, *lamellosa* ...	Darjeeling ...	24·91	11·92	5·48	6·44	8·57
8	,, *spicata* ...	Do. ...	16·83	12·90	3·00	9·90	11·90

As regards the utilisation of these barks in India for tanning purposes, it must be noted that the conditions prevailing in this country are quite different from those in Europe. The European tanner is obliged to resort to Oak bark and even to Oak wood, which contains only 5 per cent. of tannin, as they are the only good tanning materials available in Europe which he is able to obtain

at a moderate price. In India, on the other hand, some excellent tanning materials, like Babul bark and myrabolans, are so abundant and cheap that hitherto the Indian tanner has not found it worth his while to pay attention to less accessible and necessarily more expensive materials such as Oak barks. The European tanner can afford to pay Rs. 4-8 per maund for his Oak bark containing 12 per cent. of tannin, while the Indian tanner gets a much superior Babul bark, containing 16—20 per cent. of tannin, at about Re. 1-4 a maund. Under the circumstances the Oak bark can only find a market in India if it can be brought down from the hills of Chakrata and Naini Tal to Cawnpore, or from the Darjeeling hills to Calcutta, at the rate of 12 annas a maund. Only when other tanning materials are scarce is it likely to fetch a higher price than this.

The tannin extracts prepared from Oak bark and wood are well known in Europe as good tanning agents and it will not be difficult to find a market for the extracts made from the Indian Oaks if they can be manufactured at the cost of £6 per ton. The usual rate for Oak wood extract in Europe is £10 per ton and the cost of the extract amounts to £8 per ton. The European manufacturer of this extract, therefore, makes a gross profit of about £2 per ton. The quality and the percentage of tannin in the Indian Oak barks is similar to that of the European species, but the Indian manufacturer will be obliged to meet the extra cost of freight, both of railway and ship, before he can land his goods in England for sale. This extra cost would amount to £3 per ton and hence he will have to reduce the cost of manufacture to £6 per ton in order to make a profit of £1 per ton. 130 tons of air-dried bark would give 25 tons of extract having 20 per cent. of moisture, taking an average of 20 per cent. of the extractable in an average bark. The cost of these 25 tons of Oak bark extract should not be more than £150 or Rs. 2,250. At this rate, it will not be profitable to use the Indian bark for tannin extraction unless the cost of collection and transport from the hills to a central factory can be brought down to Rs. 10 per ton which at present does not appear to be possible. Thus though there may

be an inexhaustible supply of the bark in distant hills, it is commercially speaking, impossible to utilise them unless extensive arrangements of transport are made to reduce the cost of the bark.

This question of the utilisation of Indian Oak barks as tanning agents, or as materials for the manufacture of tannin extracts is, at present, kept open at the Forest Research Institute. Mr. Pearson, the Forest Economist, is engaged in collecting the required data as to the cost of collection and transport of these Oak barks from the hills to a central market or factory-site and the inquiry will be pushed further only if the cost of bark permits of a profitable business.

Extensive areas of Oak forest undoubtedly exist, but the commercial utilisation of the barks must depend on the cost of collection and the prices obtainable for it.

PURAN SINGH, F.C.S.,
Forest Chemist.

A SHORT NOTE ON *TERMINALIA TOMENTOSA* BARK AS A MATERIAL FOR THE MANUFACTURE OF TANNIN EXTRACT.

The *sein* tree (*Terminalia tomentosa*) is very abundant and the bark is almost a waste product in many of our forests. In 1899, the Inspector-General of Forests selected this bark as a subject for special investigation with reference to its value as a tanning agent.

Samples of bark were accordingly examined at the Economic Laboratory, Indian Museum, with the following results :—

Description of the sample.	Locality.	Moisture %	Tannin %	Total water extract %
Bark from old trees	United Provinces	12·6	11·8	20·5
Do. from coppice trees ...	Ditto ...	19·4	12·3	26·00
Do. from old branches ...	Ditto ...	10·0	13·6	19·7
Do. from mature trees ...	Goalpara ...	11·8	8·6	15·5
Do. from old branches ...	Do. ...	12·0	5·7	7·5

In addition to these, three samples of this bark were sent to the Imperial Institute, London, for examination and the following results were recorded :—

Description of the sample.	Locality.	Moisture.	Total extract.	Tannin.	
				In air-dried bark.	In bark dried at 100.
Bark from an old trunk ...	U. P. ...	8·72	15·25	9·24	10·12
Do. from trunks of old trees ...	Bilaspur ...	9·4	19·8	13·8	15·2
Bark	U. P. ...	10·5	25·8	17·3	19·3

The Forest Chemist has recently examined a sample of this bark from the United Provinces with the following results :—

Moisture %	Soluble solids %	Non-tannin %	Tannin %	Tannin on the dry material %
33·80	13·66	3·72	9·94	15·01

The bark on an average may be taken to contain about 13 per cent. of tannin and 20 per cent. of total extractive matter. It is very similar in its properties to the tannin of Sal bark. The *sein* bark tans harsh leather, imparting to it a violet-red colour, hence it is seldom used for tanning purposes in this country, where far superior barks can be had in fair abundance. At times, this and also Sal bark are used in Indian tanneries in very small quantities and in mixture with other superior barks and tan-fruits. The quantity used by native *Chamars* in their primitive methods is also very small, as they also know the use of better tanning materials. Owing to the inferior colour of the tannin in the bark, it seems impossible to create a large demand for this bark in India. The most profitable outlet for it appears to lie in the manufacture of suitable tannin extracts for export purposes and in accordance with this idea an inquiry regarding the value of tannin extracts prepared from this bark was started early in 1899. Fifteen different samples

and extracts were then made at the Dehra Dun Forest School and sent to the Imperial Institute, London, for examination and valuation. As these extracts were boiled like cutch in ordinary open pans, most of the tannin was lost during preparation, the extracts acquiring a very dark colour. The extracts were pronounced to be very poor in tannin and very highly coloured and they were found to produce very stiff leathers possessing an objectionable dark violet colour. They were thus quite useless for tanning purposes and were unsaleable in England. Professor Dunstan devised a method for the decolourisation of these extracts based on the use of sodium bi-sulphite as a decolourising agent and by this process he prepared extracts both from Sal and *sein* barks at the Imperial Institute, which gave leathers free from harshness and objectionable colour. Professor Dunstan then suggested that the *T. tomentosa* extract should be prepared on a large scale in vacuum pans on the lines laid down by him and that the extracts after being decolourised with sodium bi-sulphite should be sent to him for examination. This suggestion was followed up and samples of Sal and *sein* tannin extracts prepared (so it is said) according to Prof. Dunstan's method were sent to the Imperial Institute for valuation in the year 1906. The results of the examination of the samples are given below :—

Serial No.	Description of the extract.	Treatment.	Moisture °/₀	Sodium bi-sulphite °/₀	Matter insoluble in water °/₀	Soluble solids °/₀	Tannin °/₀	Tannin on dry material and free from sodium bi-sulphite °/₀
1	Prepared from the bark of young trees.	No sodium sulphite added.	55·7	...	0·3	44·0	31·7	71·5
2	Do. do. ...	Sodium sulphite added.	47·7	8·9	0·9	51·4	25·0	56·3
3	Do. from old trees	No sodium bi-sulphite added.	61·1	...	12·5	26·4	11·4	29·3
4	Do. do. ...	Sodium bisulphite added.	53·0	6·3	...	47·0	19·0	46·6

These extracts were prepared at the Rangoon tannin factory. It will be seen that the extracts made from the bark of young trees are richer in tannin than those from the bark of old trees, but all the four samples are very low in their tannin value. On small tanning trials being made with these extracts at the Imperial Institute, they were found to give rather dark-coloured leathers. The colour in every case was found to be much darker than that produced by the extract made experimentally by Prof. Dunstan himself at the Imperial Institute. This was certainly due to faulty preparation of the extracts at Rangoon. Prof. Dunstan rejected the extracts Nos. 3 and 4 of the above table as too dark to be of any commercial value while Nos. 1 and 2, in his opinion, might possibly form satisfactory agents when used in conjunction with lighter-coloured materials, such as myrabolans and Babul pods, etc. They were, however, all too poor in tannin to allow of their profitable export to Europe and Prof. Dunstan suggested that a market for them should be found in India and the neighbouring countries. "It has," says Prof. Dunstan, 'already been pointed out in this and the previous report that, as a rule, *Shorea robusta* and *Terminalia tomentosa* barks do not furnish tanning extracts which are very rich in tannin or exhibit special qualities and, therefore, it is unlikely that such products would find a sale in European countries, but an outlet might be found for them in India."

In India, however, there is at present no demand for tannin extracts as most of the tanneries employ the method of bark tanning. Thus, it will be seen that the investigation regarding the utilisation of the bark of *T. tomentosa* for the preparation of tannin extracts, which was started in 1899, has up to date only given negative results. The bark by itself is not a good tanning material and the tannin extract prepared from it has been pronounced to be of no commerical value in the European market.

This enquiry is still kept open at the Forest Research Institute, as the writer believes that it may be possible to produce an extract of considerably higher quality than that which was mannfactured at Rangoon as mentioned above. Extracts pro-

duced by up-to-date methods should again be sent to England for another trial before we finally pronounce the bark to be of no commercial value as a material for the manufacture of tannin extracts.

PURAN SINGH, F.C.S.,
Forest Chemist.

THE TRUE SELECTION SYSTEM.

In an article under the above heading in the May *Indian Forester*, Mr. Channer draws attention to a point which has not always received proper consideration in existing Indian Working-Plans. It has often not been appreciated that the rotation actually employed is not that corresponding to the age of the smallest trees felled, but half the number of years in the Felling Cycle in excess of this.

Mr. Channer, however, goes further, and argues that under the Selection System an accumulation of I class trees (or those which have attained the minimum girth) is unnecessary and involves a stagnation of capital. He bases his argument on an ideal condition that trees felled are regularly replaced by young trees which develop precisely as the average tree has developed in the past. He suggests a system of transformation felling which he claims would do away with the necessity for an accumulation of I class trees, and would establish a normal growing stock in a forest worked on a 120-year rotation in 2 Felling Cycles of 30 years.

Though I think I may claim to have been the first to urge attention to the capital employed in Indian forestry, yet I cannot agree that trees which have attained the minimum girth under the Periodic Selection System are stagnant capital, or that in practice his proposals will overcome the necessity for having such trees on the ground.

In some respects Mr. Channer seems to confuse the True Selection System, in which the whole forest is worked over every year, with the Periodic Selection System in which a part only is worked over annually, and fellings repeated at intervals of a

Felling Cycle. Circumstances in India such as the great extent of forest, the small controlling staff, the distance and restricted number of markets, etc., preclude, as a rule, the application of the True Selection Method.

Given a forest throughout which all ages and sizes of trees were more or less evenly scattered at the outset, the mean girth of trees felled, even under Mr. Channer's scheme, will during the whole of the first rotation depend on the minimum girth fixed and the increment trees have been able to put on since the last felling. In subsequent rotations the extent to which the ideal of trees reaching maturity just when they are to be felled is attained will depend on the rate and uniformity of growth of the trees.

The ideal can only be fully realised if trees felled during the first rotation are regularly replaced by others which develop at the rate calculated at the outset as the average.

In practice every forester appreciates that for innumerable reasons regeneration is not equally quickly established in all parts of a forest, and that the rate of growth of individual trees varies considerably. I think Mr. Channer only assumes the reverse as a theoretical possibility. Personally I do not think that with the best treatment we can prescribe we should be content to expect the average future production of our forests to be no better than that of the past. Assuming, however, that it will show no improvement, though the limits may be narrow, about one-half the trees will exceed and one-half fall short of the average.

In other words, in the second rotation it will be a girth-class of trees and not trees of one exact girth which willhave to be felled. In consequence there will always be a number of so-called I class trees on the ground, some of which will even exceed the mean girth before they are felled. Other things being equal the number of these trees will vary directly with the length of the Felling Cycle.

Again, since the age of individual standing trees approaching maturity cannot be ascertained with accuracy, and they cannot generally be recognised even as belonging to a certain age-class,

unless the Felling Cycle is excessively long, it follows that for practical purposes a *minimum* as *well* as a *mean size of exploitability* has to be determined.

I quite agree with Mr. Channer that steps should be taken to reduce the irregularity of our Selection forests, that so much stress should not be laid on equal annual outturn from each Felling Series, but that it should be sought to work them to the greatest profit calculating the most suitable rotation as best we can with the information available. In fact we are both against the old "Conservative Management."

But Mr. Channer apparently fixes the Felling Cycle for his transformation fellings just as arbitrarily as the Working-Plans he criticises, while he admits that its length and the minimum size of tree felled actually determine the rotation employed.

In the circumstances already described assuming the Periodic Selection System has been chosen for adoption, the girth which best suits the objects of management determined, and rotation corresponding calculated, the correct procedure is to weigh the merits of Felling Cycles of different lengths. In doing so the following considerations occur to me:—

(1) That the annual coupe must be economical to work ;

(2) That the minimum size of tree felled must be such as will not involve very considerable sacrifice, while the average tree felled must be that which best suits the objects of management ;

(3) That the fellings must be sufficiently heavy to ensure regeneration and shall recur sufficiently often to prevent mature trees interfering with the development of crops of the future ;

(4) That the Felling Cycle should be a sub-multiple of the rotation.

With 6 feet girth fixed as the exploitable size, a rotation of 120 years and a rate of girth increment (say constant) of 1 foot in 20 years, then if the Felling Cycle is 30 years trees down to $5\frac{1}{4}$ feet must be felled if the future average tree is to be 6 feet and similarly with a 20-year Felling Cycle trees down to $5\frac{1}{2}$ feet

must be felled for the same reason. In the first case though the sacrifice in felling small trees is greater, the extraction will be more economical on account of greater concentration. Again with the longer Felling Cycle better provision can be made for the regeneration of a light demander, though the further light requirements of the young trees can receive attention at long intervals only, and a larger number of I class trees must necessarily be kept in the forest.

It is wrong to ascribe the existence on the ground of I class trees to the 18" girth-classes so commonly adopted for enumeration purposes. They are a necessity during the first rotation of a forest worked under the Periodic Selection System and thereafter they can only be so far reduced as it is possible to calculate a more correct average rate of growth and make the trees conform with it.

On reconsideration I hope Mr. Channer will agree that, by a careful consideration of the effects, direct and indirect, of the length of Felling Cycles on our Selection forests, we are likely to bring them to a state of normality (perhaps even ideal) more quickly and profitably than by any transformation fellings based on such arguments as he advances for his 5 feet minimum girth.

In conclusion, I can only express grave doubt whether, as Mr. Channer would like to assume, many girth minima laid down in Working-Plans have been proved to be sound financially.

A. D. BLASCHECK, I.F.S.

THE TRUE SELECTION SYSTEM.

In the issue of the *Indian Forester* for May 1913, Mr. Channer discusses the Selection System under the above title.

The author's views of what a true Selection System forest should be seem to me contrary to the usually accepted definition of such a forest. His true Selection forest would be one composed of annual coupes, each coupe containing a number (five in the example taken) of definite age-classes, *each class being practically even-aged.* On the other hand, I have always supposed

that a rue Selection forest is one in which theoretically at least every age of tree is represented throughout the whole area equally, the age-classes being unlimited; in number and completely intermixed. Practically too, even when annual coupes are formed, the scattered nature of fellings and the varied conditions to which the growing crop is exposed seem to preclude the possibility of concentrating one age-class to any extent.

Mr. Channer, however, assumes that after a Selection Felling has taken place an approximately even-aged class of trees will immediately spring into existence, and not only this, but that they will also maintain their even-aged characters. This appears to me wholly contrary to all practical experience. Even in the Uniform System where everything possible is done to favour such a state of things the regeneration is seldom fully complete in under ten years, and with certain species or under unfavourable circumstances the period may be indefinitely prolonged. But in the Selection System who can guarantee an even approximately even-aged regeneration? Mature trees are selected for felling one here, another there, and in each case the varying circumstances such as intensity of light, nature of the soil, vigour and number of other competing species, the pre-existence of seedlings, proximity of fertile seed-bearers, etc., may vastly influence the formation of and rate of growth of the regeneration. So much so must this be the case that in my opinion no even approximately even-aged regeneration will ever result, or if approximately even-aged its rate of growth will have been so variously affected as to produce no class of approximately even girth which for practical purposes is the same thing since all fellings must be based on girth.

Then Mr. Channer has given us an example of how in his opinion transformation fellings for the introduction of the true Selection System might take place. In this example 5′ is made the minimum girth of exploitation during the first cycle of 30 years, $5\frac{1}{2}'$ during the second cycle of 30 years, and 6′ during the third and subsequent cycles.

He, moreover, says that "in the third cycle a minimum and mean girth of 6′ would be attained." This means that in this

cycle he will have produced a class of approximately even-aged trees whose girth will vary but little from 6′. Now firstly I disagree with this for reasons already stated. I do not believe the Selection System can produce such rigidly separate classes, and I maintain that all classes will completely graduate into one another. And secondly: Why should it be supposed that the operation during the first cycle of felling all trees over 5′ and during the second all trees over $5\frac{1}{2}$′ will affect in any way the trees forming the mature crop in the third cycle?

Surely it cannot affect them, and if 6′ is subsequently maintained as the minimum girth of exploitation no mature trees can have been affected before the fifth cycle, the mature trees of which were "in embryo" during the first cycle and therefore affected by it. The mature trees in the third and fourth cycles are part of the original crop which has been in no way affected by Transformation or any other fellings as regards its even-agedness, and therefore no "minimum and mean girth of 6′" can yet have been attained any more than it would have been with ordinary Selection Fellings. Also I cannot understand how the proposed Transformation Fellings would have any permanent effect whatever on the state of the crop, the only effect being a temporary disturbance during the first three cycles. This appears obvious from the table below which represents the changes undergone in coupe I during the first four cycles. I, II and III represent the normal number of first, second and third class trees :—

		Over 6′.	$4\frac{1}{2}$′ to 6′.	3′ to $4\frac{1}{2}$′.
Year 1 (1st cycle)...	Taken out	I	$\frac{2}{3}$II	...
	Left in	... ...	$\frac{1}{3}$II	III
This has become by 31st year ...	... ...	$\frac{1}{3}$I	II	III
Year 31 (2nd cycle)	Taken out	$\frac{1}{3}$I	$\frac{1}{3}$II	...
	Left in	... ...	$\frac{2}{3}$*II*	*III*
This has become by 61st year ...	... ...	$\frac{2}{3}$I	II	III
Year 61 (3rd cycle)	Taken out	$\frac{2}{3}$I	...	...
	Left in	... ...	II	III
This has become by 91st year ...	... ...	I	II	III

The object of Mr. Channer's transformation was, I gather, twofold : firstly to make the mean girth of exploitation the determining factor for working-plan prescriptions instead of allowing the mean girth to be decided by the minimum girth and an arbitrary fixing of the felling cycle, and secondly to prevent any accumulation of first class trees.

I have already explained that in my opinion an accumulation of first class trees is unavoidable since the very nature of a Selection forest prevents the formation of a definite number of even-aged classes.

The argument adduced by Mr. Channer against the fixing of a minimum girth is, I consider, based on a misconception of what is meant by fixing the minimum girth at say 6′ and saying that 6′ trees are mature. Surely what we mean is that as far as we can calculate from existing data trees below 6′ if felled would result in a loss financial or otherwise, but that trees between 6′ and about 7′ if felled would not result in such loss. Existing data of all sorts are extremely meagre and to prescribe trees as mature between say 6′ and 7′ is probably quite as accurate as the data warrant.

It must be remembered also that with the usual rotation of either the number of years it takes a second class tree to become a first, or of something less than this, the rate of growth becoming slower and slower, the mean girth of exploitation would not be 6′ 9″ but would probably be below 6′ 6″ and in the case of Sal with a thirty years' rotation might be only 6′ 3″.

On page 216 Mr. Channer has explained the difficulties which arise in the practical application of the Selection System, and I should remark here *en passant* that he appears to have meant $\frac{1}{15}$ instead of $\frac{1}{5}$ as the proportion of the whole area on which 30 trees will be found. But might I suggest that if instead of fixing the number of trees to be felled each year the much-scorned minimum girth of exploitation were the basis of fellings then, though the outturn during the first felling cycle would undoubtedly be unequal, a proper distribution would have been obtained for the second cycle, and by a judicious arrangement of

coupes during the first cycle it is probable the inequality there might be reduced to an insignificant amount. In any case the inequality would be small compared with that necessitated by the proposed Transformation Fellings.

A. E. OSMASTON, I.F.S.

DAMAGE TO TEAK BY FIRE.

On page 254 of the June 1913 issue of the *Indian Forester*, Mr. Leete remarks on the fact that no one investigates the damage done by fire and recommends that this should be done by girdling officers. While marking for a Selection felling over a small coupe in mixed teak forest in May last I took some notes with the intention of sending them for publication in this Journal.

The forest is mixed teak, *Dalbergia latifolia*, *Grewia tiliæfolia*, *Lagerstrœmia microcarpa*, *Anogeissus latifolia*, *Pterocarpus Marsupium*, *Terminalia tomentosa*, etc., etc. The forest is very open with scanty undergrowth, poor regeneration of the better species and much grass in places.

The area has been fire-protected for many years successfully (25 to 30 years), but seems only of late years to have shown beneficial results. Seven or eight years ago, before a working-plan was framed, a number of teak were felled for conversion into spokes and felloes and apparently the best trees were felled. The elevation is about 2,900 feet and the rainfall averages 60 inches.

As I have already stated elsewhere, teak suffers far more from fire than any other species and I send two photographs showing typical damage (Plate 10). The first represents serious damage, but the tree is still partly fit for timber; in the second instance the injury is so serious that the resulting timber must be converted into small articles. Stems of 10" in diameter and less do not as a rule show signs of injury by fire, presumably they have appeared since fire-protection started. For this reason I left these out of account.

The following is the result of my counting :—

1 tree showing no signs of damage.

DAMAGE TO TEAK BY FIRE.

Fig. 1. Injury serious but stem partly useful for timber.

Stem unfit for timber.

1 tree showing very slight signs, but the tree is dead.

13 trees with comparatively slight injuries.

13 trees with serious injury, but partly fit for timber (see Fig. 1.)

107 trees seriously injured and unfit for timber and may be unfit for anything but firewood.

This refers to coupe V, Punachi Working Circle, in the *Anaimalai Hills of South Coimbatore.*

Hard by an experiment has been started this year, an area of one acre is to be burnt over year after year and the results compared with the surrounding unburnt forest.

COIMBATORE :
1st July 1913.

C. FISCHER, I.F.S.,
Deputy Conservator of Forests.

TROPICAL AGRICULTURIST, Vol. XL, No. 5, MAY 1913.

This well-known monthly journal (annual subscription Rs. 8) which was founded in 1881 by Mr. J. Ferguson, C.M.G., has now entered upon a new era of its useful existence, it having been purchased by the Ceylon Agricultural Society who are now sole proprietors. Correspondence regarding the Journal, therefore, should in future be addressed to the Secretary, Ceylon Agricultural Society, Peradeniya and not as hitherto to the *Ceylon Observer* office. The subjects discussed in the Journal are naturally those which chiefly interest the Agriculturist and the Planter, but various matters, such as the conditions of soil and methods of cultivation which are found to favour the successful growth of the various plants dealt with, are also of importance for the Forester. The present issue contains a very interesting article on *Hedychium coronarium* and its value as a paper-pulp material. The plant apparently covers extensive areas in Brazil where it takes possession of land which has been cleared for sugarcane to the exclusion of other vegetation. The species occurs in Ceylon and also in India, but in these countries it is not believed to occur naturally in large quantities in any given locality. In comparison with rice straw, pulp-wood and bamboo this plant is said to give "a greater weight of raw material per acre than any other product listed" (*i.e.*, 6—10 tons of dry raw material per acre per annum).

Incidentally, however, it may be pointed out that in India we possess a species (*Saccharum arundinaceum*, Retz.) which occurs naturally over large areas in Burma, Assam and possibly elsewhere, which is a first-class pulp-material and which is capable of yielding as much as 14 tons of dry raw material per acre per annum.

DRUG CULTURE IN BRITISH INDIA.

BY DAVID HOOPER.

The cultivation of medicinal and aromatic plants in the Colonies has recently been considered by the Dominions' Royal Commission in London. Though India was not represented on the Commission, it must be admitted that this Empire is exceedingly rich in medicinal plants, perfumes and spices that are known all over the world. India embraces vast tracts of tropical plains, with temperate hills and valleys, irrigated soil, moist, and dry climates, and cheap labour. To these advantages may be added the scientific skill of members of the Agricultural and Forest Departments of Government, whose energies are directed to the improvement of crops and trees of economic importance. While the present exports of drugs are large, India possesses great possibilities in the matter of extending the cultivation of those which are largely imported and rendering herself more independent of foreign supplies.

On consulting the last edition of the British Pharmacopœia it will be noticed that a large number of vegetable drugs come from India, and an equally large number may be raised in the country. This is exhibited in the two following columns, where

No. 1 includes those drugs which are indigenous or are recognised as East Indian and No. 2 enumerates those grown on a limited scale and are capable of extended cultivation and exploitation :—

No. 1.	No. 2.
Aconite root.	Aloes.
Areca nut.	Belladonna leaves.
Indian hemp.	Belladonna root.
Capsicum.	Caraway.
Cardamom.	Coriander.
Cassia Fistula.	Colchicum.
Chirata.	Colocynth.
Cinchona bark.	Digitalis leaves.
Croton oil.	Fennel seed.
Hemidesmus root.	Gamboge.
Kino.	Ginger.
Linseed.	Henbane.
Nux vomica.	Ipecacuanha.
Castor oil.	Jalap.
Opium.	Liquorice root.
Pepper.	Podophyllum root.
Pomegranate bark.	Resin.
Red sandalwood.	Rhubarb.
Sandalwood oil.	Saffron.
Senna leaves.	Stramonium leaves.
Tamarinds.	Turpentine oil.

A few notes on the experiments that have been made in India on the acclimatisation of medicinal plants will show what success has attended the efforts. If the industry were better organised and received the support of the Medical Department the cultivation could be more widely developed.

Atropa Belladonna.—Belladonna grows in the Western Himalayas, from 6,000 to 12,000 feet from Simla to Kashmir. Sir George Watt has stated that the Himalayas might supply the world with belladonna; but the supply of the leaves and root and their preparation continues to be imported. Persistent efforts were made to acclimatise the plant at Saharanpur and Mussoorie from 1880 to 1888. Seeds sown at Saharanpur in the autumn came up freely, but little or no growth was made by the seedlings, and they all died soon after the advent of warm weather in the spring. At

Mussoorie the plants sometimes lived for about eighteen months, but they never attained to more than weakly-looking herbs before dying out. An analysis made of the roots in 1906 showed a yield of 0·7 per cent. of alkaloid. The cultivation of the plant has recently been revived in the Kumaon Hills, and the results so far have been encouraging. The leaves have yielded 0·28 per cent. and the roots 0·4 to 0·45 per cent. alkaloid A difficulty has been experienced in drying the leaves in the monsoon when they are abundant. The active principle is said to be higher when the plants are four years old. The plant would be more successful on a northern slope in the interior of the Himalayas at 8,000 to 9,500 feet, and a trial goes far to confirm the expectation. It has no chance of succeeding on the plains of India.

Aloes.—During a visit to Karachi, made last August, it was astonishing to see the large number of aloe plants growing on the coast. The plants were probably *A. abyssinica,* Lam., the source of the Jaferabad aloes. They were extremely succulent and with little labour an inspissated juice could readily be made from the leaves. Should the commercial supply become scarce the Sind coast would afford abundant material for an indigenous extract.

Colchicum autumnale.—The corms and seeds are used in medicine. Mr. Gollan, of Saharanpur, writes :—"In 1882 the Indian Medical Department was importing about Rs. 500 worth of the drug annually, and on this account an attempt was made about this time to acclimatise the plant at Mussoorie, but without success. The imported corms remained healthy during the winter and early summer months, but a large proportion rotted in the rains, and by the time the flowering season was due in autumn only a few appeared above ground. These seldom or never flowered again and withered. In eighteen months or two years from date of introduction all had disappeared. The monsoon rainfall on the outer Himalayan ranges is apparently too heavy for the plant to make progress."

Other attempts have been made to grow meadow saffron in India, but with very little success. It appears very desirable to

institute an inquiry into an allied plant, *Colchicum luteum*, Baker, as a substitute. This plant grows on the slopes of the Western Temperate Himalayas, and the roots constitute the Hermodactyls of the Greeks and the bitter "Surinjan" of the Indian bazars The alkaloid, colchicine, has been detected in the corms and seeds and a supply has been sent to England for chemical and physiological investigation. *Should C. luteum be found to be equal in* activity to *C. autumnale* its cultivation could be readily extended.

Digitalis purpurea.—Foxglove grows in Himalayan and other temperate regions in India. Dr. Ainslie, writing more than a century ago, says that in his time it was grown in Bangalore. It is quite acclimatised on the Nilgiris, and grows without any attention. These hills have supplied the Medical Stores with the dried leaf for many years. The plant is perennial at Arrigadh, in the United Provinces, and its cultivation was taken up in 1880 with a view to furnish the Indian Medical Department. The Superintendent, writing in 1885-86, did not anticipate any difficulty in supplying the Medical Stores with the annual requirement of 60 lbs. In 1886-87, 44 lbs. of leaves were supplied at the rate of 4 annas per lb., the cost of which, compared with the rate of Re. 1-8 per lb. charged at Bombay, showed a saving to Government of Rs. 55. It was afterwards found that the price was 8 annas per lb. in the open market, and the experiment was abandoned. In some hill districts its growth is slow, and the old plants have a habit of damping off in the rains. The plant, grown near Ootacamund, supplies 100 lbs. of dry leaf each year to the Medical Stores Department, Madras. It is easily raised from seeds sown at any time during the spring months. The plant does not survive after being stripped of its leaves.

Dr. Martindale has examined some Indian-grown leaf supplied by me, and in his paper on "Digitalis Assay" the chemico-physiological tests compare favourably with those of the leaf grown in England.

Hyoscyamus niger.—Henbane is a native of the Temperate Himalaya from 8,000 to 11,000 feet. It was for a long time successfully cultivated at Hewra, Deccan, by Dr. Gibson, and at

Dapuri, near Poona, by Dr. Lush, for the supply of the extract to the Bombay Medical Stores. Henbane was introduced into the Saharanpur Botanic Garden about the year 1840, and since that time up to the present day the Indian Medical Department has obtained all its annual requirements in the shape of extract and dried leaf. It is sown at Saharanpur during October in rich, highly manured soil. It grows very fast and requires no care further than thinning and weeding in the early stages and attending to the water-supply afterwards. Leaf is plucked and dried from the latter end of December to the end of January, and the extract is made during February.

It has been calculated that the plant may be grown and the extract prepared much more cheaply than that imported from England. The average rate at Saharanpur for ten years has been Re. 1-4 per lb. for the extract, and 4 annas per lb. for the leaf; while the quotation in England for the extract was 6*s*. 3*d*. per lb., and 10*d*. for foreign and 8*s*. per lb. for English biennial leaf. Hyoscyamus was formerly largely grown in the Botanic Gardens, Sibpur, and the product made over to the Calcutta dispensaries. There is no record of when or why Government directed this practice to cease.

Ipecacuanha.—The attempt to acclimatise ipecacuanha in India would make a long story. The first experiments were undertaken in Northern India by Dr. Anderson, and afterwards by Dr. King, of Calcutta. In the Rungbi plantation in Sikkim the plants were tried under a variety of conditions as regards soil, sun and shade, and several, numbering about 6,000, were raised in prepared land at an elevation of 3,000 feet. It was found to be a small creeping under-shrub of very slow growth that requires a tropical climate with pretty equal day and night temperature and an atmosphere saturated with moisture. In Sikkim the plants are still grown, and cuttings have been distributed to other parts of India, but no supplies of the root have been sent to the Medical Stores or exported to Europe. In South India cultivation has also been attempted for several years. The first plant was introduced by Dr. Cleghorn in the Government Gardens, Ootacamund, in

1885. In 1870 Mr. McIver planted a few cuttings in the Experimental Gardens at Burliyar. These succeeded fairly well, but it was considered that they could not be grown as an article of commerce. In 1881 several plants were transferred to the teak forest at Nilambur, the climate of which seemed to suit their growth much better than at Burliyar. The growth, however, was slow, and the protection required in the cold season so considerable that it was calculated that the drug could not be produced in any quantity at the usual market rate, more recent experiments have been made at Kullar, at the foot of the Nilgiri Hills, but reports show that these have not been made on an extensive scale. The Indian grown root has been found to be medicinally active and to contain emetin equal in amount to that found in the commercial article, but a certain amount of capital and persistent efforts are required to make the cultivation a success.

Ipomœa Purga, Hayne.—Experiments were made in the cultivation of jalap tubers near Ootacamund, Nilgiri Hills, prior to 1870. In January of that year Mr. Broughton sent to Mr. Daniel Hanbury a cluster of tubers weighing 9 lbs. The regular cultivation commenced in 1877 under Mr. Jamieson, Superintendent of the Botanic Gardens and Parks. The plant is readily propagated by root and stem cuttings placed 3 by 3 feet apart in peat soil. The plant being herbaceous and throwing out twining stems, it is supported by stakes, or trellis work in the same manner as ordinary garden peas. An acre of land will give 1,000 lbs. of dry tubers at a cost of 3 annas per lb. The Medical Store Depôt at Madras has for some years been supplied with this drug from Ootacamund. Jalap is a drug that responds readily to manuring. The amount of active resin found in the root is between 10 and 12 per cent., which answers to the requirements of the British Pharmacopœia. In 1896 experiments were made with fertilisers, and it was found that the percentage of resin increased to 1 per cent. in tubers grown with phosphoric manures. One large tuber which had grown in the neighbourhood of a manure heap afforded as much as 22 per cent. of resin, which may be considered the largest yield on record.

In Northern India the cultivation of jalap has not been so successful. The plant was introduced in Chajini Garden, near Mussoorie, about forty-five years ago, but after a few years ceased to exist. Subsequently some roots from Ootacamund were conveyed to Arrigadh, and great attention was given to the plant for some years. Growth was at all times slow, but for a time the plants were healthy and fairly promising. In 1887 Dr. Warden examined samples of the tubers supplied to the Medical Store Depôt, Calcutta, and found in them from 6·4 to 10·7 per cent. of resin. Unfortunately, the tubers grown near Mussoorie were subject to an attack of a fungoid disease resembling potato murrain, and no headway could be made with increasing the stock. No success attended the culture of the plant in other parts of Northern India.

The annual requirements for jalap in the Medical Stores, Bengal, are 2,000 lbs.; Bombay, 1,000 lbs.; and Madras, 1,200 lbs. There is no reason why the whole of this supply should not be obtained from the Cinchona Plantations, Ootacamund.

Podophyllum emodi.—Since the announcement made by Dr. Dymock and myself in 1889 that the root of Indian podophyllum was richer in active resins than the American podophyllum the drug has been frequently examined and has secured a position in the Indian and Colonial Addendum to the British Pharmacopœia. The demand for the root is still on the increase, as it is sometimes difficult to obtain a sufficiency of the American drug. The Forest Department has taken up its cultivation in the Punjab, United Provinces, and the North-West Frontier Provinces, and several maunds of dry root are now supplied annually. In Kamalhan and Malkandi, where the climatic conditions are favourable, the cultivation is being extensively carried out, and the product is sold at Rs. 8 per maund. Suitable organisation should ensure for this drug a wider market and a satisfactory profit to Indian producers.—[*Pharmaceutical Journal.*]

INDIAN ROSIN AND TURPENTINE.

[*The following Report on the possible markets for Indian Rosin and Turpentine, manufactured at the Government Distillery, Bhawali, near Naini Tal, United Provinces, has been forwarded to us by Mr. E. A. Smythies, Assistant Conservator of Forests, Nain Tal Division, United Provinces.*]

The two products obtained by the distillation of crude oleo-resin, namely, turpentine and rosin, are put to such different uses, that the markets and consumers are usually quite distinct and we may therefore consider them separately.

By far the greater portion of *turpentine* used in India is consumed by the paint trade, and as the manufacturers of paint are the most critical, it is certain that if we can satisfy the paint trade, we shall have no difficulty in selling all the turpentine we can produce.

For the purposes of paint manufacture, an oil of good quality should show the following essential characteristics: (*a*) It should be colourless; (*b*) it should evaporate quickly and evenly; (*c*) it should have no sticky residue.

As regards the first of these properties, we find no difficulty in obtaining a colourless oil, provided we take care to remove all traces of water, and prevent rusting in the tins. Since 1908 we have never received complaints on the ground of colour.

The evaporation of turpentine depends on two factors, namely, (*i*) the specific terpenes which make up the essential oil, and (*ii*) the presence or absence of impurities. The first of these factors is determined by the species of pine from which the oleo-resin is obtained, and purest oils obtainable from different species will be quite different in their chemical and physical properties. Turpentine obtained from *P. palustris* (the principal American pine) consists of almost pure Pinene, the lightest and most volatile of all the terpene family, hence the very favourable position the American turpentine holds.

Turpentine from *P. longifolia* (the principal Indian species) consists, as far as the researches carried out at the Imperial Institute and elsewhere show, a mixture of Pinene (boiling point 156° C.)

with a heavier terpene of higher boiling point, possibly sylvestrin, with a boiling point of 175° C.

This of itself, however, is not sufficient to make Indian turpentine unsuitable for paint manufacture. For instance, French turpentine (from the maritime pine) also contains a high boiling terpene, and it is readily taken by paint manufacturers ; moreover, its price is generally slightly lower than that of best American turpentine. We have sufficient grounds, therefore, for considering that Indian turpentine could be obtained of a sufficiently good quality for the purpose of paint trade.

This leads us to a consideration of the question of the presence or absence of impurities in our Indian turpentine, with which is intimately connected the most objectionable characteristic of a sticky residue. It is an undoubted fact that turpentine, as it has been manufactured in these Provinces, does contain impurities, and does leave a sticky residue. It is also an undoubted fact that it is due to these impurities that our oil dries slowly, and leaves this residue, the chief, in fact the only serious objection that consumers of our oil have made, and which has prevented, and still prevents, American turpentine from being challenged by Indian turpentine in Indian markets.

Finally, the long series of experiments, first instituted in 1908, and subsequently carried on by the Forest Chemist, conclusively show that these most objectionable impurities, and the sticky residue, are due to faulty distillation, and to this cause alone, and the excessively high temperature to which the resin has to be heated before the distillation is complete, is the fundamental fault that we commit

The corollary we can draw from this is that if or when we perfect our method of distillation, and eliminate the mistakes we at present make, we should have no difficulty in competing with American turpentine in Indian markets.

For over 4½ years we have been experimenting to try and correct faults, and eliminate the sticky residue, and although the oil has been much improved, yet perfection has by no means been reached. We have learnt, however, that we can obtain oil of

excellent quality by secondary refining and redistillation of the oil obtained direct from the crude resin. But with our present plant this procedure is very slow, laborious, and expensive, and any improvement in price due to the improved quality of oil, would not compensate for the increased cost of production. Recent experiments have therefore been directed towards finding a method of distillation, which, by keeping the temperature relatively low, produces a good oil without an increase of cost of distillation.

Both in the Punjab and in these Provinces there is every indication that Steam-distillation will ultimately be adopted, as giving the best results at the smallest cost, and it is scarcely too much to hope that it is only a question of time and further experiment, before we shall be obtaining a turpentine of sufficiently good quality.

It may be pointed out, however, that with the rapid development of the Resin Industry, and with the output of turpentine steadily increasing every year, it becomes a matter of some urgency to correct our faults and obtain a good quality of oil in the near future.

Largely with this object in view, a considerable sum is to be spent on the complete reconstruction of the distillery, whereby fire heat will be entirely eliminated, and distillation will be carried out by steam only. At the same time the oil, as it is obtained, will be simultaneously redistilled, which, it is anticipated, will give the finest quality of oil obtainable from the oleo-resin of *P. longifolia.*

Apart from the quality of the oil, the question of the method of packing must be seriously considered. The matter of leakage on consignments of oil sent from Bhawali habitually crops up. and is a fruitful source of much correspondence and annoyance. The average leakage on Calcutta and Bombay consignments last year was 3 per cent., but the leakage rose occasionally to 10 per cent. or more. The form of packing at present adopted consists of second-hand empty kerosene oil tins and boxes, and with increasing demand, we have to go further and further afield to meet requirements. During the last two months, for instance, we have indented on Almora, Ranikhet, Naini Tal, Bareilly, Moradabad,

Agra, Pilibhit and Lucknow. These tins and boxes are the best solution of the problem of packing that we have yet reached, but there is no doubt that they always will show some leakage, and it is not a sound policy to offer consumers a good quality of oil packed in leaky cases, which must tend to give an unfavourable impression. The question of packing is becoming increasingly important, and requires thorough investigation.

It is not easy to obtain accurate figures of annual imports of American turpentine into British India, but it is believed that the quantity cannot be less than 200,000 gallons. With steady commercial and industrial expansion, the demand is bound to increase.

To put the whole matter briefly, we cannot hope to compete with imported turpentine until we have perfected our method of distillation and packing, but we have grounds for considering that with our present faults eliminated, there would be a demand for Indian turpentine fully equal to our maximum possible output.

To turn now to the possible *markets for rosin*. The chief consumers of rosin in India may be briefly summarised as follows :—(1) the Paper Mills ; (2) the Soap manufacturers ; (3) the Shellac manufacturers ; (4) the Varnish makers ; (5) in addition to these, there is a large local demand in the United Provinces and the Punjab for a number of petty industries, which absorb about 800—1,000 tons per annum ; further details of this demand are given below. There may be other large consumers, but if so, we are not yet in touch with them.

We will consider these possible markets for Indian rosin separately, and will first discuss the local demand which has up to this year absorbed all our output, but which is beginning to show signs that it will not absorb very much more. It is almost impossible to get into direct touch with these local petty consumers, and this demand has always been met in the past through Marwari firms in Cawnpore, Delhi, etc., who act as middlemen, and incidentally take a handsome profit. It is understood that the manufacture of native bangles absorbs a considerable quantity of this rosin, but exact information seems difficult to obtain. We know, however,

that the Cawnpore market can absorb about 200—250 tons per annum, Delhi about the same quantity, Hathras, Meerut, Agra, Amritsar, and Lahore also take up smaller quantities.

We also know that these markets are not very particular as to packing, and rosin for these up-country markets is sent off in gunny bags, a cheap but very unsatisfactory method, especially in the hot weather, when the rosin melts and oozes out, or picks up quantities of dirt and gravel.

To turn to the possibility of sales to the Paper Mills. We have in the past sent samples and trial-consignments to several Paper Mills, and in each case complaints were made that the quantity of dirt and gravel in the rosin made it quite unfit for paper-making. This was undoubtedly due to the faulty packing in gunny bags and partly to careless filtration. Through a series of very fine meshes, we can now obtain a perfectly clean rosin, but the question of a suitable packing material is a more serious matter.

We have fully realised that gunny bags are impossible for the despatch of rosin to Calcutta and the more distant markets, and for the Paper and Shellac trades especially, which demand absolutely clean rosin, some form of wooden packing seems essential. Amongst various forms of packing tried, chir pine barrels appear to be the most promising.

One sample thus consigned has been favourably reported on, and a contract has been concluded to supply a Paper Mill with 10,000 maunds during the current year. Doubtless other Paper Mills will follow this example in future years.

To turn to the Soap manufacturers. We have already obtained the contract for the supply of rosin to one such concern, during the present year, and are sending them 250 maunds per quarter. It is therefore clear that the quantity of our rosin is sufficiently good to meet the requirements of the Soap manufacturers.

With regard to the Shellac manufacturers, it is believed that they require a ruby red clear rosin free from dirt and other impurities. With our old plant, and old method of distillation, we could not obtain a suitable colour, but considerable improvement

has been obtained with our new steam-distillation process, and samples of this superior grade of rosin are being sent to various consumers in Mirzapur and Calcutta. It is too early yet to say anything definite about this market, but we shall doubtless know in a month or two if our rosin is suitable for this shellac trade.

There remains to be considered the possible supply to the Varnish trade.

In March 1910 we sent a 10-ton trial-consignment of rosin in gunny bags to a firm in Calcutta. The firm concerned reported that the consignment had been badly melted by the heat, and had to be dug out of the wagon with pickaxes. The loss of rosin was considerable, and needless to say, no further orders were placed with us. Again in May this year, a similar quantity was sent but packed in wooden boxes, the firm reported that the consignment arrived in good condition, and was quite satisfactory.

It is therefore evident that the question of a suitable packing material for our rosin is the principal factor which at present prevents its more extended use, and this problem is being seriously tackled. If barrels and boxes prove satisfactory and economical, it will ultimately be necessary to erect a small saw-mill at Bhawali to turn out planks and staves, and to employ our own coopers, when we shall be in a position to manufacture our requirements on the spot. The supply of suitable timber in and around Bhawali is ample.

The total output of Indian rosin during 1912 (about 23,000 maunds) was rather more than could be absorbed by the local market, and a certain amount was sent to Calcutta and Bombay. During the present year, the total output of Indian rosin will be nearly 40,000 maunds, of which probably 25,000 maunds will be sold in Calcutta and Bombay as the local market still has stocks left over from last year's yield. Arrangements have been completed for turning out 1,000 to 1,500 barrels at short notice, and with this form of packing, and with the improvement in quality, it is anticipated that a ready market will be found. The outputs of rosin from the Bhawali, Kalsi, and Lahore distilleries have been sold to the end of March 1914.

In future years we hope to extend our sales to the Shellac manufacturers, and other consumers, as our output grows.

The following table shows how the Resin Industry is being developed (actual figures are given for the past years, estimates for future years) in connection with the Bhawali Distillery only :—

Financial year.	Number of trees being tapped.	Yield of resin.	Yield of turpentine.	Yield of rosin.
		Mds.	Galls.	Mds.
1910-11	194,000	14,000	21,000	9,500
1911-12	213,000	17,000	25,000	12,000
1912-13	400,000	30,000	45,000	20,000
1913-14	600,000	45,000	67,500	30,000
1914-15	700,000	52,500	75,750	35,000
1915-16	800,000	60,000	90,000	40,000
1916-17	900,000	70,000	105,000	47,000

The maximum output from the Bhawali Distillery is at present estimated at 100,000 maunds of crude resin per annum, giving 150,000 gallons of oil and 67,000 maunds of rosin. If some form of cheap mechanical transport was possible, tapping operations could undoubtedly be still further extended, with a corresponding increase of yield. On the other hand, any increase in railway freight, *i.e.*, in the cost of delivery of the distilled products to the principal markets (as occurred last year), is bound to decrease the ultimate total yield.

In addition to the Bhawali Distillery, a new distillery will shortly be started at Tanakpur, the maximum output from which will probably be at least 20,000 maunds of resin per annum. Furthermore the Punjab Government Distillery at Lahore, which up to the present has been on a more or less experimental scale, will be rapidly developed in the near future. It is believed that the annual output of resin from the Punjab will be 50,000 maunds.

The total Indian production of rosin and turpentine will thus rapidly increase during the next few years and a comparison between 1910-11 and 1916-17 shows that the output will be increased approximately nine times.

Year.	Province.	Resin.	Turpentine.	Rosin.
		Mds.	Galls.	Mds.
1910-11 ...	United Provinces ...	15,000	22,500	10,000
1916-17 ...	Ditto ...	90,000	200,000	90,000
	Punjab	40,000		

With a growing Indian demand, however, it is doubtful if there will ever be any available surplus for export. It is at least certain that there will be no export from India for some years to come.—[*The Indian Trade Journal.*]

VEGETABLE HAIR INDUSTRY OF THE SOUTH.

Vegetable hair or so-called Spanish, long or black moss, is an epiphytic plant growing on a good many different kinds of trees in the south-eastern United States, West Indies and South America. The largest and most tenacious kind grows on the bald cypress in the South Atlantic and Gulf States. It is known botanically as *Tillandsia usneoides*. The specific name *usneoides* means "like *Usnea*," a generic name of a gray lichen or so-called "moss," which is common along the coast as far north as New Jersey, and which it resembles, but to which it is in no way related. The common name "moss" is a misnomer for the plant, because it is not a moss at all, but belongs to the pine-apple family of plants (*Bromeliaceæ*). While this plant grows upon another, it does so without deriving any nourishment from its host as does a parasite. It is more of the nature of an air-plant, and hangs in long festoons from the branches of the trees throughout the moist regions of the South. It is generally considered that it does not

interfere with the growth of the trees upon which it grows, except in cases where it is very abundant.

The collection of this plant is a growing industry in the South and constitutes one of the important minor forest products, which is usually overlooked. It hangs from the branches of the trees often within easy reach, and is gathered in the time of the high floods when the swamps are easily accessible by small boats. The gathering is done by negroes at intervals of seven years on the same trees. After it is collected it is placed in large piles on the borders of the swamp, packed closely, and left to decay for about a month. During this time the linear-awl-shaped leaves and the grayish, scurfy, cellular tissue surrounding the firm, hair like elastic fibre partly rot away. It is then dried thoroughly in the open air when it loses about 90 per cent. of its weight. In this state the material is shipped to small gins located in various parts along the Gulf Coast, where it is further dried, perfectly cleaned by machinery, and baled for the market. During the process of cleaning the material is washed in boiling water and soap. It is then hung out on racks to dry and finally dusted in a fan-mill. In the operations of ginning and cleaning it loses about 35 per cent. in weight. When the moss has passed through these processes a dark, coarse, tough fibre is left, which resembles horse-hair. To impart a uniform colour to the article it is sometimes dyed jet black, and the best qualities can hardly be distinguished from horse-hair. It is used extensively for stuffing mattresses, cushions, and the like. It is usually mixed with horse-hair.

There are no data at hand to show the present annual production and consumption, but the value of the prepared vegetable hair in the South may safely be estimated at about $600,000.—[*Scientific American.*]

DEAR TIMBER.

The abnormal rise in the price of teakwood in India, although said to be temporary, is not likely to fall readily considering the increasing demand for it, for, although heavy teak beams are giving way to beams of steel, the consumption for all other purposes is steadily going up. There is at present no other timber that can take its place, although the researches of Mr. Pearson, the Forest Economist at Dehra Dun, upon preservative processes may afford relief by bestowing the quality of resistance against white-ant and rot upon some cheaper and more common wood. There is no lack of forests and timber of large size in India, especially in the hill districts, but the ground is so uneven, the hillsides so steep, and the means of transport so imperfect, that the value of the wood at the nearest market is not sufficient to pay the cost of carriage and leave a profit. Travellers whose journeyings carry them beyond Simla into what are known as the "Hill States" will see immense quantities of standing timber of a kind used for building purposes, for which there is very little sale owing to lack of transport facilities. Perennial rivers and even seasonal torrents suitable for carrying logs are very rare; of roads for wheeled carts there are none. The average angle of the hillsides is nearly 50 degrees and, owing to the difficulty of handling logs on such slopes, they are cut to short lengths and sawn into boards or scantlings on the spot and carried on the backs of men to their destination—at times a distance of many miles. This wood cannot be carried by mule, as the mule paths have so many turnings following the contours of the hillsides that it would be a serious danger to other traffic. A tree is felled so as to fall downhill. It is then stripped, cut to lengths and dragged to the nearest suitable place where it may be cut up by saws that are very rarely in good working condition. The log is raised at one end only for sawing, and the cutting is retarded in consequence and often irregular. No attempt is made to use rope blocks and cattle to haul the cut wood up the steep slopes to the mule path. All this heavy and poorly paid work is done by the hillmen, a hardy and well-built race, who seem to expect nothing better in life. The general rise

in wages has reached the wood-cutters in the forests, and contractors are enquiring for mechanical aid in tree felling, for the wood-cutters have at times a disconcerting way of obtaining advances, and suddenly disappearing before they have worked off the debt. There are machines that will fell a tree growing on level ground, but when it grows on a hillside with an angle of 60 degrees, it is hard enough to get at it with the axe, not to speak of a cross-cut saw. The problem is nevertheless not quite hopeless. An axe removes the greatest amount of wood in felling a tree, and involves the squaring of the end, afterwards ; a saw removes the least wood and leaves the end squared, but it requires a good foothold at opposite sides of the tree, which in very many cases does not exist. A proposal has been made to cut trees by drilling a parallel row of holes by means of a portable electrically driven tool, or even by hand, which could be operated upon one side only of a tree. This would remove more wood than the saw, but much less than the axe. It is a matter for the designer of wood-working machinery electrically driven, whose source of power might be many miles away from the scene of work. The same power might be utilised in handling the wood upon steep slopes where it must be raised to a road instead of being lowered to a lake or navigable river as in other countries.

The engineering section that it is proposed to attach to the Department of Forests will doubtless do much valuable work in preparing roads and means of transport for timber between forest and market, as well as in providing better and more economical appliances for cutting wood and promoting forest industries that are so conspicuously lacking in India.—[*The Indian Textile Journal.*]

SAW-DUST AS A FIRE EXTINGUISHER.

Saw-dust as a fire extinguisher sounds absurd, but recent experiments in Boston proved it to be very successful in quenching fires in oil, and much superior to sand for fires in tanks of inflammable liquids. The experiments were conducted with tanks of burning lacquer, though the same principles appear to apply largely to tanks of burning oil. The floating saw-dust forms a blanket that shuts off the air from the flames; and, as saw-dust itself catches fire only slowly, and then does not burn with a flame, the saw-dust blanket was completely successful in putting out the fire in these tests. It made no difference whether the saw-dust was wet or dry.—[*The Timber Trades Journal.*]

PAPER CANNON.

To the amazingly long list of articles made of paper there may be added paper cannon, which have been manufactured at the Krupp works in Germany. These paper field pieces are for special use of the infantry. Their calibre is a little less than two inches, and the pieces are so light that a soldier can easily carry one. But the resistance is greater than that of a field piece of steel of the same calibre. It is not to be understood that these paper guns are in any way to replace those made of steel. The paper arms are intended merely for use in situations where the movement of field artillery would be impracticable. Paper artillery on the field of battle seems an extraordinary thing; but it is hardly more so than paper wheels for freight cars on railways appeared when they were first introduced, or, for that matter, than water pails were.—[*Paper Trade Review.*]

CALOTROPIS PROCERA, A NEW DIGITALIS SUBSTITUTE.

Calotropis procera, the African Asclepiadaceous tree which is widely spread in the tropics, and its congener, *C. gigantea*, have long been employed as poisons. *C. procera* yields abundance of a poisonous, thick latex. This contains caoutchouc, and an albuminoid, as well as resinous substances. All these are inactive, but the serum which remains after their separation by coagulation has an intense action on the heart, similar to that of digitalis. This clear liquid obtained by coagulating the latex by boiling has a bitter taste and a peculiar odour somewhat like that of conine, which is rendered more evident on adding sodium hydroxide. The nature of this odorous substance has not been determined. On evaporating the serum the active principles separate out as a brownish amorphous mass, becoming hard when cold. It is only sparingly soluble in cold water, but is soluble in alcohol giving a greenish fluorescence. By addition of ether to the alcoholic solution a whitish-yellow substance, more or less pure, is precipitated. This is considered to be the chief active principle and has been named calotropin. It is a powerful poison, arresting the heart's action in systole. It is suggested that from its resemblance in pharmacodynamic action to digitalis that the serum of *Calotropis* might be used instead of that drug.—L. Lewin (*Med. Klin.*, 1913, 306; *Nouveaux Remédes*, 1913, 36, 193.)—[*Pharmaceutical Journal.*]

SEASONING OF TIMBER.

A French process of "electrocuring" timber is stated to give perfect seasoning in a single night. With lead-plate electrodes on each side, the timber is placed in a solution containing ten per cent. of borax, five per cent. of resin, and a little soda; and application of the current expels the sap and fills the wood cells with the borax and resin.—[*Capital.*]

DURABILITY OF WOOD PAVING.

Striking evidence of the long life of creosoted deal paving, even when subjected to London traffic, is seen from the blocks taken up in Elgin Crescent, which is being repaved by the Improved Wood Pavement Co., Ltd. These blocks, which were laid twenty years ago by the same firm, although worn, are, we understand, quite sound, the creosote having thoroughly preserved the wood. That this is not an isolated instance can be gathered from the fact that Westbourne Grove, Kensington, paved by this company in 1887, was not repaved until twenty years later; whilst the paving in Earl's Court Road lasted seventeen years, and in the main Uxbridge Road, Acton, sixteen years, to quote only a few of many instances.—[*Timber Trades Journal.*]

OZONE AND PINE TREES.

What is the reason that pine and fir trees, and others of the species, are surrounded, more than other trees, by ozone, and that therefore forests of the "needle-leaved" trees are so health-giving? If the theory of Prof. Lemstrom, of Helsingfors, is correct, this can now be explained; for the "needles" act on the atmosphere as generators of electricity, so that the *trees are always surrounded* by electricity, and consequently by ozone. Prof. Lemstrom began his researches in this direction by studying the uses of the spikes or "beards" of grain (wheat and rye) which he found to be generators of electricity which the plant requires for its proper development.—[*Scientific American.*]

THE LEAF-PERIOD.

From a study of the growth and fall of the leaf in perpetual summer, botanists in Java and Ceylon have been lately seeking new light on an old subject. At the Botanic Gardens at Buitenzorg, G. Volkens has found the climate not quite uniform, as there is a periodicity in precipitation, relative humidity, and insolation; and from records of more than 100 species growing in the Gardens

he has obtained illustrations of nearly every kind of foliage behaviour—some trees being regularly deciduous once or twice a year, certain evergreens having marked periodicity, and others having uniform foliage gradually renewed throughout the year. He concludes that the leaf-fall is not due to the checking of activity by an excess of stored food, some unknown internal action of the protoplasm seeming to him the primary cause. On the other hand, G. Klebs decides that periodicity of plant habit is governed by periodicity of external conditions, and that the supply of food materials may play a leading part. His conclusions are based partly on experimental altering of the periodicity. Trees stripped several months before the usual time have renewed their foliage and continued it during the season when they are usually bare; some deciduous European trees in the tropics no longer wholly dropped their leaves at any season; and tropical trees of periodic habit have been made to change their period by varying the fertility of the soil.—[*Capital.*]

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OCTOBER, 1913.

THE PATRIATA ROPEWAY.

(*Illustrated.*—PLATES 11 & 12.)

The Troops stationed at Murree and the lower Gallis consumed for many years previous to 1909 such large quantities of firewood, that the forests in the immediate vicinity of Murree were quite insufficient for their requirements. Their average consumption was nearly 100,000 maunds a year. Of this about 40,000 maunds a year came from the Patriata Reserve, distant about 11 miles from the nearest Troops, where, owing to the inadequate supply of bullocks, the greatest difficulties were experienced in carrying the outturn of the yearly coupes. Carriage of one year's fellings frequently extended over two or even three years.

In order to shorten this period of extraction and to reduce the cost thereof, proposals for erecting a wire ropeway were put forward in 1908. The general lack of mechanical means of transport in the Himalayas also rendered the initiation of a project for building a Ropeway of the greatest value for experimental and instructional purposes.

The Patriata Reserve occupies the top of a long ridge parallel to the Murree ridge and separated from it by two deep valleys taking off on either side of a median watershed which runs at right angles to both ridges and is at its lowest point over fifteen hundred

feet below both. The line of the watershed now forms approximately the line of the Ropeway.

The estimate put forward by Mr. Jerram, the then Divisional Forest Officer, was for Rs. 10,000 only for a gravity ropeway down the Patriata Hill to Galehragalli, the lowest point of the watershed. The services of Mr. Percival, I.F.S., were obtained in June 1909 and at his suggestion the project was extended to include uphill carriage to Charihan some eleven hundred feet above Galehragalli and distant about one and a half miles from the Murree-Kashmir cart-road. Mr. Percival estimated the expenditure at Rs. 35,000. A very large quantity of firewood had been collected near the proposed ropeway-head, and Mr. Percival especially noted that if the Ropeway was not erected in time to carry this firewood, *i.e.*, by June 30th, 1910, the prospect of the Ropeway being a financial success would be jeopardised. Delays from one cause or another, especially in the time taken for a survey, caused the project to hang fire; but a fresh calculation by Mr. Jerram seemed to prove that if the Ropeway was erected by October 1st, 1910, it would still be financially profitable.

Accordingly about the middle of March 1910, the Punjab Government telegraphed final instructions to the India Office to complete the purchase of the Ropeway on the condition that the contracting firm should deliver the Ropeway erected and in working order by October 1st, 1910. This condition was considered of vital importance by the Forest Department, as no Forest *Officer in the Punjab had the experience necessary* to erect so complicated a piece of machinery. The India Office, however, merely placed the contract for delivery with Messrs. Ropeways, Ltd., the important condition of erection being omitted. The price also was considerably in excess of the original order.

The Sappers and Miners and the Public Works Department were then asked to erect the plant, but were unable to do so and it was eventually arranged that the Public Works Department should build the foundations and be responsible for the engineering details of erection under the supervision of an expert engineer sent from England by Messrs. Ropeways, while the Forest Department saw to the supply of materials and generally helped in the

work of erection. Actually the greater part of the engineering work was done by local craftsmen under the competent supervision of Mr. Underhill, Messrs. Ropeways' expert, assisted by the staff of the Rawalpindi Forest Division. Mr. Wright, Assistant Conservator of Forests, was placed on special duty to help Mr. Underhill.

The foundations were not ready till September 3rd, 1910. The Ropeway was erected and in working order by December 3rd 1910, but was only able to carry about 480 maunds daily, owing to the buckets not being adapted to the carriage of anything but straight pieces of wood. In other respects these buckets were unsuitable and accidents frequently occurred. Various defects were remedied by Mr. Underhill, Ropeways' expert, and a new form of bucket was designed, so that by the beginning of June 1911 the Ropeway was running smoothly and able to deliver with comparative ease 3½ tons per hour, and a maximum of 4 tons per hour.

Owing to the above facts the cost had risen from Rs. 35,000 of the original estimate to Rs. 63,000 and this increase naturally affected the rate at which wood could be carried. This rate is a little under annas 3 per maund of 82 lbs. calculated on the quantity 40,000 maunds annually carried from Patriata. The Ropeway can deliver when working for six days, of 8 hours each, per week some 20,000 maunds per month. The cost-rate of carriage falls rapidly with the amount of wood carried for the reason that the fixed charge of interest and the charge for depreciation bear a very high proportion to the monthly working expenses. The Ropeway is capable of being worked for at least 16 hours daily; even then a very substantial margin is left for effecting small repairs and cleaning the engine. This means that it could carry the whole of the outturn of the Patriata Forest, *viz.*, 40,000 maunds, in one month. It could be worked for at least ten months a year and thus possesses ten times the necessary efficiency. The mistake has been made of purchasing a plant of large carrying capacity for a comparatively small project.

So long ago as 1899 the General Officer commanding the 2nd (Rawalpindi Division) has expressed his intention of burning

coal should the Forest Department be unable to guarantee a sufficient supply of firewood for the Troops at Murree. Notwithstanding the fact that fireplaces for burning coal were gradually built the Troops still consumed a yearly average of 96,000 maunds of firewood for the three years previous to 1910. No contract was entered into with the General either before or during the construction of the Ropeway and in February 1911 the Forest Department found itself with the Ropeway and some 120,000 maunds of firewood on its hands with no market other than that of the Troops at Murree. For this wood the General offered a price that was much below the expenses incurred on its carriage, and expressed his intention of burning coal. He eventually took over the whole stock at a figure which was practically the expense incurred by the Forest Department exclusive of the value of the wood, but refused to give the Forest Department any guarantee that the Troops would burn wood in future. (In estimating the profits of the Ropeway no notice was taken of this very considerable drop in the price of firewood. The fees credited to the Ropeway were such as would enable it to be worked at a profit, the fall in the selling price of the wood being debited to the value of the wood in the forest.) This supply lasted till December 1912 when the balance, about 30,000 maunds, was destroyed by fire. The Forest Department had carried some 25,000 maunds of firewood over the Ropeway and by restricting all fellings in the neighbourhood of Murree were able to induce the General to conclude a contract for five years at very satisfactory prices which will enable the Forest Department to recover a large proportion of the capital sunk in the Ropeway. The Supply and Transport have also profited by this transaction and estimate that they will save some Rs. 8,000 a year on their fuel contracts in Murree and the Gallis.

DESCRIPTION.

The length of the Ropeway is 3 miles. The loading station is situated at an elevation of 6,387 feet on the Patriata Hill ; there is an intermediate loading station at Galehragalli at an elevation of 5,454 feet and an unloading station at Charihan at an elevation of 6,567 feet, 180 feet above the loading station and 1,113 feet

PATRIATA WIRE-ROPEWAY.

Ft. 1 0 1 2 3 4 5 6 Ft.

ROPEWAY BUCKET.

FIG. 1. (*End Elevation*)

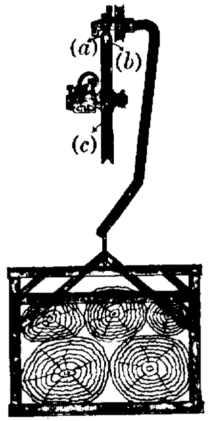


FIG. 2. (*Side Elevation*)

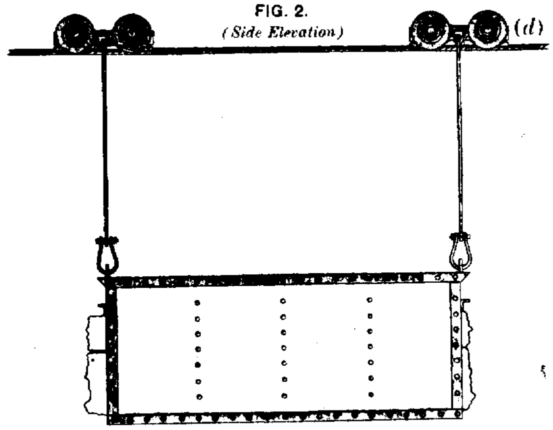


FIG. 3. UNLOADING STATION.

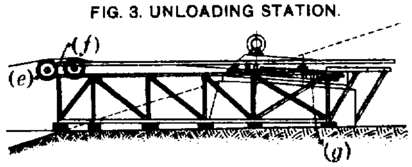


FIG. 4. UNLOADING STATION.

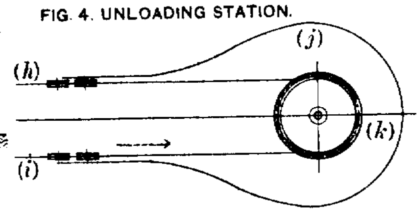
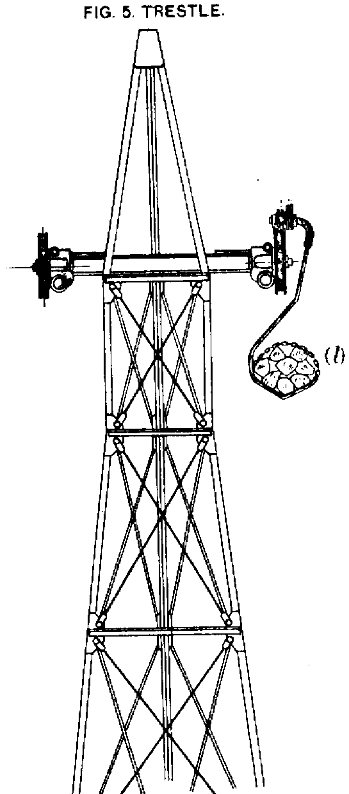
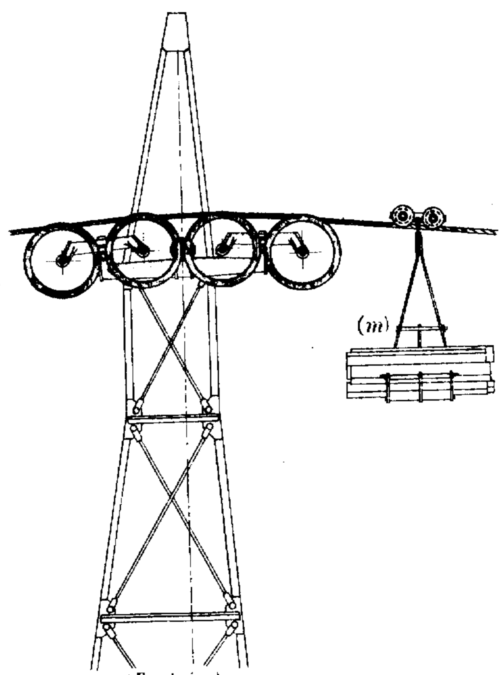


FIG. 5. TRESTLE.



(*End view*)

FIG. 6. TRESTLE.



(*Front view*)

REFERENCES.

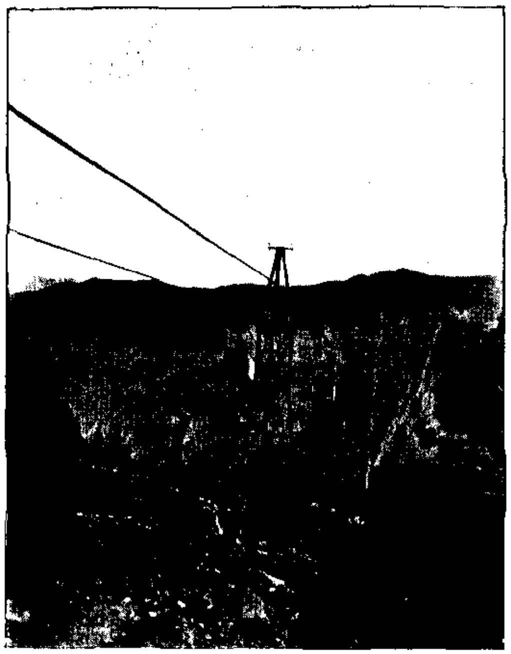
(*a*) Clip; (*b*) Rope; (*c*) Trestle-sheave; (*d*) Boxhead; (*e*) Full buckets; (*f*) Bent end of rail; (*g*) Gear-wheel; (*h*) Rope; (*i*) Full carriers; (*j*) Rail; (*k*) Wheel; (*l*) and (*m*) Bucket of old pattern.

above the lowest point at Galehragalli. Owing to the configuration of the ground the line of the Ropeway changes its direction at Galehragalli, the horizontal angle thus formed being 7°.

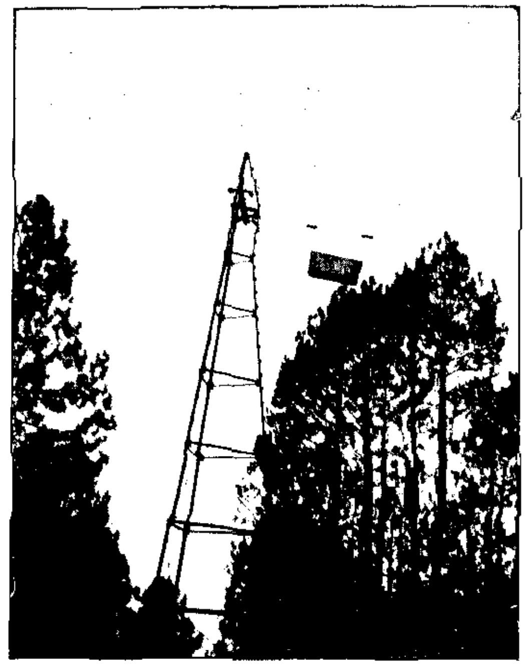
The Ropeway consists of an endless wire cable, which passes round horizontal wheels at Charihan and Patriata, underneath tilted depression wheels at Galehragalli, and is suspended at intervals along its course on vertical wheels (technically known as sheaves) supported on tall trestles. (Figs. 5 and 6. Plate 11.) These trestles are made of steel beams and are fixed on concrete foundations. The cable is made to revolve by an engine connecting with the horizontal wheel at Charihan. This engine is of 20 horse-power and consumes wood fuel. Buckets (Figs. 1 and 2. Plate 11) for carrying wood are hung from the cable at intervals, and are automatically placed on and lifted off the cable at the loading and unloading stations. A bucket consists of a box of dimensions 5 feet 2 inches by 2 feet by 2 feet, open at the top and at both ends and made of galvanised iron sheets riveted on to a framework of angle-iron. To each end of the box is attached an iron suspender fitting loosely into a "boxhead." Each boxhead possesses two clips loosely attached to it and also a pair of small wheels for running on rails at each loading station. The clips are hollow semi-cylinders of steel with an internal steel projection which catches between the strands of the cable and prevents the clips slipping along the cable, but allows them to be lifted off by upward vertical pressure. At the Patriata and Charihan stations are rails running nearly parallel to and slightly above the rope, so that the wheels of the boxheads carrying the buckets mount on them and lift the buckets off the rope automatically. (Figs. 3 and 4. Plate 11.) As the rope moves round full buckets are placed on it at Patriata and are automatically lifted off at Charihan, while empty buckets are returned in the same manner in the opposite direction. Operations are controlled by a telephone and an alarm gong. This alarm gong can be rung by connecting its wire to earth anywhere along the line of the Ropeway, thus ensuring immediate stopping of the engine on the occurrence of an accident. The despatch of loaded buckets is regulated by a bell worked by a gear-wheel and bicycle-chain connected to the horizontal wheel at Patriata. Most of the

essential parts of the Ropeway are patents of Messrs. Ropeways, Limited. They do not get out of order easily and have not as yet required to be replaced except in occasional instances. Accidents were at first of frequent occurrence, but are now extremely rare. The original type of bucket supplied (Figs. 5 and 6. Plate 11) was most unsuitable and was the cause of many accidents. Projecting pieces of wood fouled the trestles and the buckets themselves occasionally slipped down the rope and fell from it. The new pattern, described above, is much more satisfactory and has the advantage of being able to carry sawn timber up to at least 12 feet in length. Messrs. Ropeway consider that the clips are safe up to an inclination of the rope of 1 in 2. No slips have occurred for more than a year. It is essential for the rope and all moving parts to be kept well oiled or greased and inattention to this would soon cause parts to wear out. The big turning wheel has lately given trouble, as it has been pulled over slightly by the strain on it. This strain also causes the wire to stretch but this can be easily adjusted by a windlass at the Patriata station. The horizontal wheel at Patriata already mentioned is not fixed rigidly. It is placed on rails, and is anchored by means of a floating iron weight attached to it by a cable passing round the windlass. This floating weight keeps the tension of the rope constant, and it is necessary for it to be kept in the centre of the pit in which it is suspended. The Ropeway was designed to deliver wood at the rate of 4 tons per hour. In practice it can deliver 3½ tons per hour fairly easily and can without extraordinary difficulty deliver 4 tons per hour. The engine burns about 3½ maunds of wood per hour and uses about 500 gallons of water per day. Messrs. Ropeways state that the wearing parts should last for at least six years of constant working, while other parts should last indefinitely. The depreciation allowance has been taken at Rs. 2,781 per annum, but is probably lowly assessed. This naturally varies with the amount of work done by the Ropeway. The appendices show the expenses incurred on erection and the monthly cost of working. The Ropeway is often run for short periods by the ordinary range staff, some of whose members are quite able to execute such minor repairs as are ordinarily necessary. Messrs. Ropeways' expert

THE PATRIATA ROPEWAY



The line from the Charihan Station.
The ∤ shows the position of the loading station at Patriata.
The further ridge is the Patriata Reserve.
The line runs over the top of the lower hill in the nearer background.



Empty bucket passing a trestle.

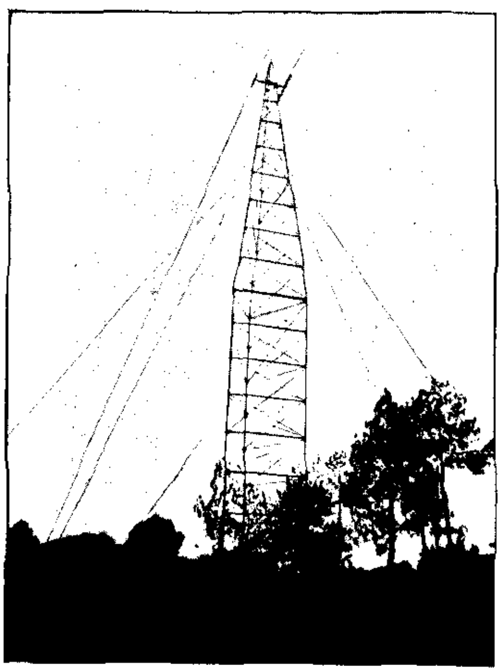
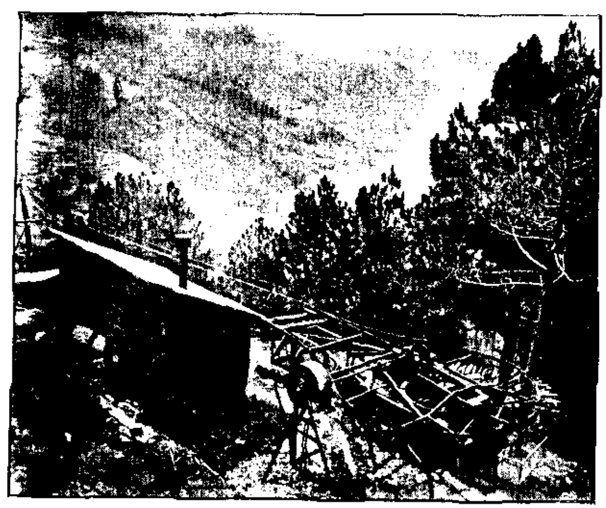


Photo.-Mechl Dept. Thomason College, Roorkee.

The highest trestle (100 feet) situated in the valley between the Patriata station and the lower hill.



Unloading station at Charihan.

[Note.—Engine not working.]

will shortly overhaul the Ropeway as the knowledge required is of a very specialised nature. It is quite probable that serious repairs to the ropeway could not be executed without his help.

STATEMENT I.—*Showing Capital Expenditure on the Patriata Ropeway.*

Particulars.	During 1910-11.	During 1911-12.	TOTAL.
	Rs. a. p.	Rs. a. p.	Rs. a. p.
1. Expert's expenses	8,833 7 6	...	8,833 7 6
2. Transport of material –			
(*a*) By rail	106 3 9	1 4 0	107 7 9
(*b*) By road	1,902 15 7	6 0 0	1,908 15 7
3. Erection, including carriage of plant after arrival at Charihan or Topa.	626 5 11	...	626 5 11
4. Sundries (*i.e.*, survey, purchase of tools, etc)	536 13 11	...	536 13 11
5. Cost of plant	35,831 0 7	4,699 5 0	40,530 5 7
6. *Masonry and excavation, including* price of lime and cement, etc.	*530 8 3*	...	*530 8 3*
7. Completion of Patriata Ropeway due to faulty design and retention of services of expert till 9th June 1911, when Ropeway was running satisfactorily –			
(1) Expert's expenses ...	474 13 0	2,580 0 0	3,054 13 0
(2) New buckets ...	1,221 14 6	...	1,221 14 6
(3) Miscellaneous ...	343 15 6	104 6 9	448 6 3
8. Estimated value of work done by Public Works Department on foundations. *Note.*—This is an estimate only and has not been adjusted in accounts.	4,452 0 0	...	4,452 0 0
Total ...	54,860 2 6	7,390 15 9	62,251 2 3
9. *Add*—Spent during July 1912 on account of balance of Railway freight charges.	...	720 12 0	720 12 0
Total ...	54,860 2 6	8,111 11 9	62,971 14 3
10. *Deduct*—Excess book expenditure adjusted by Accountant-General in August 1912.	...	2 8 0	2 8 0
Net Total ...	54,860 2 6	8,109 3 9	62,969 6 3

STATEMENT II.—*Showing the Monthly Working Expenses of the Patriata Wire Ropeway.*

Ropeway.

	Rs.
Engine Driver	40
Greaser for applying grease on the trestles, etc	9
Fireman	8
Carriage of water for the Ropeway Engine	35
Price of wood used in working the Engine for 25 days of 8 hours at 3 maunds per hour = 600 maunds, at Re. 0-2-0 per maund ...	75
Total ...	167

Charihan Station.

	Rs.
1 Forester, pay Rs. 20 and Ropeway allowance Rs. 10	30
1 Supervisor (head coolie)	9
2 Coolies for unloading trucks, at Rs. 8 each	16
4 Coolies for carrying wood from the Ropeway Station to the depôt at Re. 0-5-0 each for 25 days = Rs. 31-4-0, say	32
Total ...	87

Gatialagali Angle Station.

	Rs.
1 Supervisor (head coolie)	9
1 Coolie	6
Total ...	15

Patriata Station.

	Rs.
2 Foresters (one at Rs. 20 per mensem + Rs. 10 Ropeway allowance, and one at Rs. 15 per mensem + Rs. 5 Ropeway allowance) ...	50
1 Supervisor (head coolie)	9
2 Coolies, at Rs. 8 each...	16
6 Coolies for bringing wood from the depôt for 25 days, at Re. 0-5-0 each = Rs. 46-14-0, say	48
Total ...	123

Sundries per month	38

Oils.

	Rs.
Engine oil, 5 gallons	9
Cylinder oil, 4 gallons	8
Rope oil, 50 gallons	54
Grease, 40 lbs.	9
Total ...	80
GRAND TOTAL ...	510

H. W. GLOVER,
A. C., Forests.

FRUIT CULTURE IN KULU (PUNJAB).

The idea of popularising the culture of fruit trees among the Zamindars of Kulu and Simla originated with Sir Louis Dane, our late and popular Lieutenant-Governor, who in 1909 ordered fruit gardens to be started in Kulu, a district which is pre-eminently suitable for the enterprise.

The work of fruit culture was entrusted to the Forest Department, and I was deputed to the Agricultural College, Pusa (Behar), for special training in this industry.

On return from Pusa, where I spent about ten months in studying the different branches of the industry, I was posted to Kulu Division for the purpose of starting experimental orchards in the Outer Seraj Range. This Range was selected on account of its accessibility from Simla (70 miles on an average and connected with it with good roads suitable for hand-carts), and secondly, on account of the poor condition of the people, whose material prosperity it was desired to improve by means of this industry.

The selection of orchard sites was commenced in December 1910, and three suitable places were soon found. These sites were selected on different elevations (5,000′ to 6,700′) on different aspects and in such a way as to be generally representative of more extensive areas as regards locality and soil. Each orchard was about 2 acres in area and sufficiently large to include about 100 apples

and 100 pear trees. In each of the orchards about 100 wild pears (*Pyrus Pashia*) and 100 wild apples (*Pyrus lanata*) were planted after clearing the areas of brushwood and making water channels for irrigation. Great difficulty was experienced in finding wild apple stock, as it is by no means common in the locality and where found is eaten by the people.

The object of starting these experimental orchards was four-fold:—(*a*) to teach the people practically how to cultivate the fruit trees, (*b*) to procure a supply of grafts for distribution, (*c*) to practically demonstrate the profitable nature of the industry, and (*d*) to determine the species most suitable for any given aspect and elevation.

As early as 1892, Sir Edward Buck originated a scheme in the Simla district under which an "Inspector of Hill Orchards" was appointed, and the object of which was to help the hill people to start orchards of their own. Since that date about 5,000 fruit trees have been annually distributed from the Mahasu orchards (Simla) through the Director of Agriculture, Punjab, but so far as the undersigned is aware, no appreciable extension of fruit culture has taken place. "The trees distributed were given free to the villagers with this object. This, I am told, has been an entire failure. They took the trees, but never tended them, and though a few may survive, anything of the nature of village orchards or village fruit culture is not to be seen." Taking the above extract from a note by Mr. D'Arcy about Kumaon orchards and the practical experience gained in the Simla district into consideration, it was decided to supply the villagers only with grafts free of cost, together with the free services of *malis*, and to make them plant the wild stock themselves.

After establishing three orchards in January 1911, work among the zamindars was commenced and it was found that in certain localities the people were quite anxious to have their wild trees grafted. The wild pear (*Pyrus Pashia*) is very common in this locality, and as every field contains many such trees, the demand was chiefly for pear grafts. The grafts were obtained from the orchard of an Indian gentleman in the Kulu Valley at one anna per

graft of about 12 buds and also from Captain Banon, of Manali, who very kindly supplied them free of cost. The season being already far advanced, it was not possible to graft more than 228 pears and 80 apples for the zamindars, out of which 146 pears and 40 apples succeeded. The percentage of failures was rather heavy owing to rains and snow. Some mischievous persons spread the alarm among the people that Government would eventually impose a tax on the apple and pear trees. This idea took deep root in the minds of the people and in certain parts of the Range, the presence of the *malis* with the grafts was immediately followed by the clear felling of all the wild stock of apple and pear trees in the villages. Great efforts were made to dispel this notion, and I am glad to say, with considerable success.

During the whole of the summer of 1911 continuous tours throughout the Range were made to induce the people to take up fruit culture, and to teach them the operations of grafting and budding, but although the people paid a willing ear to the former, yet they looked at the latter with awe. They regarded the operations of grafting and budding as mysterious and impossible to be learnt.

During December 1911 and January 1912, three more orchards were started of the same area (2 acres each) in different parts of the Range, and so situated as to command the whole Range. It was found that only those people who lived in the vicinity of orchards showed a desire to take up the culture. These new orchards were also planted with 100 wild pears and 100 wild apples each. For this year grafts were obtained from England, together with 100 grafted apples and pears, but they all arrived in a bad condition and were mostly useless. Only 14 grafted plants survived and the grafts had all to be thrown away. At the eleventh hour, Captain Lee, of Bandrol orchards (Kulu), came to our rescue and very kindly supplied us with some grafts, and we were thus able to graft half the number of trees in the three orchards started in the beginning of 1911. Local arrangements were also made for providing grafts to those people, who wished for them. In this year 563 pears and 100 apples were grafted for the people as

compared with 228 pears and 80 apples in the previous year and a good many of them succeeded.

In 1913, the grafts were obtained from Messrs. Donald and Lee of Kulu Valley orchards, at 4 annas each, for grafting the Government orchards as well as for the people. All the orchards were completely grafted, and in addition to this 743 pears and 357 apples were grafted for the zamindars. This year on account of very heavy late snow the percentage of failures was exceptionally large. A rough survey of the operations of fruit culture among the people has been made, and it is believed that 224 apples and 776 pears are now flourishing in the fields of the zamindars. A few trees have borne fruit this year. Up to this time the people have contented themselves with having the wild stock grafted, which is found scattered among the fields. No serious efforts have yet been made by them to start regular orchards. There are, however, a few exceptional cases of individuals who now possess regular orchards containing from 20 to 150 trees apiece. Great difficulty is experienced in inducing the people to take up this industry, owing to their apathy, their inherent and almost invincible dislike of any institution unknown to their ancestors, the initial expenditure necessary for the creation of an orchard, the constant care required in attending to it, and the delay of some years, which must occur before the original outlay can be recouped.

We have now got six Government experimental orchards of about 2 acres each and containing about 100 apples and 100 pears (of some ten different varieties) apiece. In selecting the varieties care has been taken to obtain both late and early sorts. In addition some peaches, apricots, oranges and figs, obtained from Saharanpur orchards, have also now been planted. Some more apples, plums, cherries, peaches, and oranges have also been ordered from Australia.

The Government orchards have now been, as a rule, successfully stocked, and the few failures still existing will be re-grafted during the coming spring. The growth of the trees in these orchards is all that could be desired, and there is no doubt that in a few years these orchards will be a valuable property. Great

patience and perseverance, however, will be required to induce the local people to take up the industry on a large scale.

The principal varieties experimented with up to date are noted below :—

Apples.—(1) King of Tomkins *co.*, (2) Baldwin, (3) Blenheim Orange, (4) Cox's Orange Pippin, (5) Red Quarrendon, (6) Lord Derby, (7) Sturner Pippin, (8) Golden Reinette, (9) Ribston Pippin, (10) Beauty of Kent.

Pears.—(1) Marie Louise, (2) Knight's Monarch, (3) Duchesse de Bordeaux, (4) William's Bon Chretin, (5) Beurre Blanc, (6) Bertlet, (7) Easter Beurre, (8) Doyenne de Commice, (9) Louise Bonne of Jersey, (10) Josephine de Malines, (11) Bergamot.

Oranges.—(1) Malta, (2) Malta Blood, (3) Washington Navel, (4) Jaffa.

Apricots.—(1) Kaisha, (2) Moor Park, (3) St. Ambrose.

Peaches.—(1) Sterling Castle, (2) Alexander Nobles, (3) Duke of Wellington, (4) French Mignonne, (5) Royal George.

Figs.—(1) Black Ischia.

Besides these " King David " and " Jonathan, " the two best apples grown in Australia, but of American origin, have been ordered. " Rome Beauty ", an apple of Australian fame with " absolutely perfect " fruit, is also being introduced.

Pests.

No particular pests had to be contended with. Woolly Aphis, although noticed in Kulu Valley, has not yet made its appearance here. Peach leaf-curl disease (*Exoascus deformans*) is very common in the locality, both the wild and orchard trees being attacked. Each and every peach tree in the Ani orchard of the Salvation Army is so badly attacked, that no fruit at all is obtained. This year a spraying machine is being ordered and efforts will be made to combat the disease.

Powdery Mildew (*Podosphæra oxyacanthæ*) has appeared on a " Rome Beauty " apple-tree imported from Australia and planted in an orchard with N.-W. aspect at 6,300′ elevation. No disease

has been developed on the trees planted in orchards with a S.-E. aspect or on flat areas at 5,000′. It appears, therefore, that this apple does not like a moist climate, and it will be removed to some sunny orchard.

White-ants were found boring the stems of the plants in *Bahu orchard (5,000′ elevation on level ground)*, but they were successfully removed by pouring kerosine oil into the tunnels.

In Karana orchard (6,700′ with S.-E. aspect) the weevil, *Dereodus pollinosus*, Redt. was found attacking the wild apple stock. As no spraying machines were available, they were continuously disturbed by shaking the plants and fortunately they disappeared in the following year.

This year in the same orchard another beetle is found defoliating the trees. They appear in swarms at night time. Specimens are being sent to Pusa for identification. It is a noteworthy fact that the weevils and beetles have been found up to this time attacking the trees only in the orchards with a S.-E. aspect which are exposed to the sun throughout the day. No other orchard had any attack.

A wasp locally called "Ringal" is very common here and does a great deal of damage to the ripe apples, pears and figs. They come in swarms during the daytime and literally cover the entire trees. They are easily controlled by hanging bottles half full of honey dissolved in water among the branches of the trees. The wasps are entrapped in these bottles which must be emptied and refilled again every morning.

CHAMAI: GURAN DITTA MAL,
22nd July 1913. *Forest Ranger, Kulu Division.*

A METHOD OF MAKING ROUGH ESTIMATES FOR ROADS IN HILLY COUNTRY.

Many miles of forest roads are made every year in India and the methods of preparing estimates for them no doubt vary in different parts of the country. In the case of important roads through uneven country it may be necessary to go over the line with a level, and afterwards to plot on paper the level section and necessary cross-sections, and to calculate from them the amount of cutting and embankment required. In the case of ordinary inspection or cart-roads running through comparatively level country, on the other hand, no detailed estimates will be required, for there will be very little cutting or embankment, and the clearing of jungle, levelling of the track, and construction of side-drains are all that will usually be required; work of this kind will be carried out at local rates of so much a mile.

The majority of roads probably lie between these two extremes. That is to say, they are not of such a nature as to warrant the expenditure of the time and money which the preparation of very accurate estimates would entail, but their importance is sufficient to necessitate rough estimates being made. This note is to explain the working of an instrument which may be used in preparing such estimates. It is chiefly of use in making estimates for roads running along moderately steep hillsides, in which case the road is made entirely in cutting. The cost of embankments, retaining-walls and bridges, where necessary, may be estimated separately, but for the purpose of estimating the amount of cutting in long stretches of roads running along hillsides the instrument is very helpful. It was introduced into the Imperial Forest College lately by Mr. C. M. McCrie, and is one of the methods used by the students of the College for making rough estimates. I believe it is in use in parts of the Central Provinces, but whether it is employed in other parts of India I do not know.

In order to appreciate the advantages of the instrument it is necessary to understand the ordinary method of roughly estimating the amount of earth to be removed in cuttings. After the

road has been aligned with some simple instrument, such as the Ceylon Ghat Tracer or De Lisle's clinometer, cross-sections should be taken at suitable intervals or wherever there is a marked change in the slope of the ground. The area of these cross-sections may be found in the following way :—

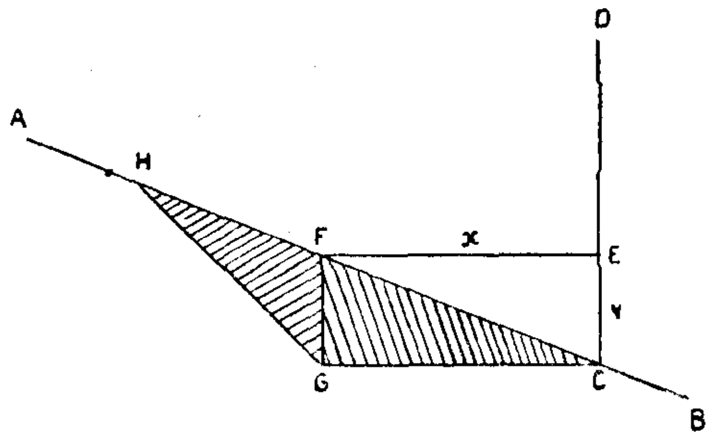


Fig. 1

Let AB represent the slope of the ground in section, and let C be a point on the alignment where it is desired to take a cross-section. A bamboo, or preferably a graduated staff, DC should be erected in a perpendicular position at C. In addition to the staff DC the estimator should have another bamboo equal in length to the required width of the road. In the above diagram the bamboo is represented by FE, and x is the width of the road. This bamboo *should be held in a horizontal position* between the staff DC and the hillside, and it should be moved up and down until it is in such a position that one end touches the staff and the other end the hillside. In the present case the bamboo touches the staff at E and the hillside at F. It is then necessary to note the height of E above C, either by reading it off the staff, if graduated, or by measuring it with a tape. In the present case it is found to be y feet.

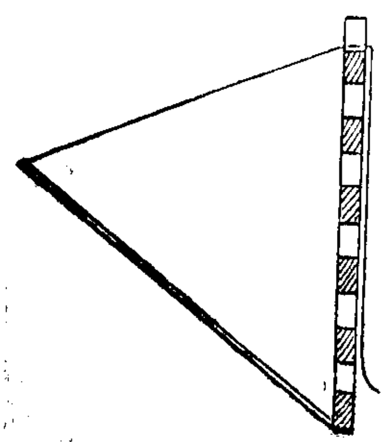
Now FE and EC form with the slope of the ground the triangle FEC. Complete the parallelogram FGCE and the triangle FGC

thus formed is the cross-section of which it is required to find the area. The area of the triangle FEC is $\frac{x \times y}{2}$, and since the triangle FGC is clearly equal to the triangle FEC the area of the triangle FGC is also $\frac{x \times y}{2}$; that is to say, the area of the cross-section at C is $\frac{x \times y}{2}$ square feet. Having calculated the areas of the various cross-sections, and knowing the distances between them, it is of course an easy matter to calculate the volume of earth to be removed.

The above method of calculating the area of a cross-section, however, neglects the fact that in order to get the base of the cutting equal to the required width of the road, x feet in the present case, the top of the cutting will have to be wider still; for the side of the road cannot, except in the case of rocky ground, remain in a vertical position, as GF, but must slope, as GH, the slope varying with the natural angle of repose of the soil. The area of the triangle HFG, will thus have to be added to the area of the cross-section already calculated. This area may of course be separately estimated, but it is not easy to do so accurately. The advantage of the instrument described below is that it obviates the necessity of estimating the area represented by the triangle HGF separately, but makes it possible to calculate the area of the whole cross-section HGC in one operation.

The instrument in question is very simple in construction, and can be made by any local carpenter. A sketch of it is given below.

Fig 2



It consists of a stout staff 12 feet high, graduated to show single feet. It is fitted with a movable bamboo arm, of about the same length as the staff, which is joined to the front of the staff by a hinge. This bamboo arm can be raised or lowered to any desired angle by means of a pulley, the cord passing through the staff as shown in the sketch, and being fastened to a nail or hook. The staff might conveniently be fitted with a plumb bob to ensure it being held vertically. It should be made of some light wood and should not be too thick ; otherwise the instrument will be clumsy and heavy.

Before commencing the estimating, the movable bamboo arm should be lowered by means of the pulley to an angle equal to the angle of repose of the soil through which the road has to be made. This can be done as follows, and the angle should of course be altered when the nature of the soil changes and becomes less or more stable. Some spot on a steep hillside in the neighbourhood, where the soil appears to be at its natural angle of repose, should be chosen, and the staff should be erected there and held vertically. The bamboo arm should then be lowered by its cord until it is lying along the slope of the hill. The cord should then be made fast and the bamboo arm kept in that position for the purpose of fixing the slope of the side of the road to be constructed.

If there is no place in the immediate neighbourhood where the soil appears to be at its natural angle, the bamboo arm should be made to assume any convenient angle with the staff. Such an angle is 45°, which represents a slope of 1 in 1 ; this is the angle of repose of damp clay, according to page 81 of Vol. II of Rogers' Engineering Manual, and when the soil is less stable this angle may be increased, thus decreasing the angle of repose, and *vice versa*.

The instrument may be set to an angle of 45° in the following manner :—

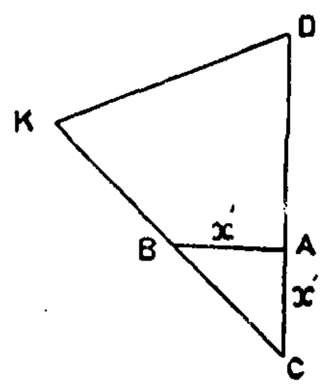


Fig. 3

Along the graduated staff CD take any convenient distance CA equal to x feet. At A set off AB at right angles to CD by means of a tape, making AB equal to x feet. Lower the movable arm *CK until it coincides with B and then fix it by means of* the cord.

Now since AB = AC, therefore $\angle$ ABC = $\angle$ ACB.
But $\angle$ BAC = 90,° therefore $\angle$ ABC + $\angle$ ACB = 90,°
Therefore $\angle$ ACB = 45°.

The instrument is used in much the same way as the bamboo above referred to. In addition to the instrument one bamboo is required. It should however be considerably longer than the required width of the road, but it should have this width clearly marked on it. The working of the instrument is explained in the following diagram, where CD represents the staff, CK the bamboo

arm, and HN the bamboo with the required width of the road, x feet, marked on it at HL.

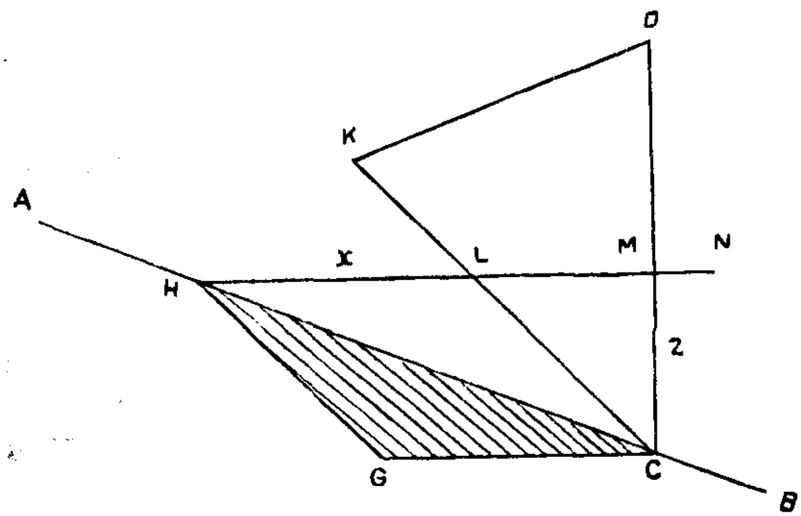


Fig. 4

The staff CD is set up vertically at C, the same point as in the previous example, the movable arm CK having been fixed in the manner explained above. In the present example it is making an angle of 45° with the staff. The bamboo HN is then moved horizontally up and down the hill until it is made to assume such a position that one end of it, H, touches the hillside and the point L touches the movable arm CK. It should then be noted where the bamboo HN cuts the staff CD, in this case at M, and the height of M above C, in this case Z feet, should be recorded.

[It is sometimes difficult to get a bamboo long enough to reach from H to the staff CD. It is in practice, however, quite easy to see where a shorter bamboo *would* cut the staff if the former were long enough.]

Now HLC is a triangle; complete the parallelogram HGCL, and the triangle HGC thus formed represents the cross-section at C of which it is required to find the area.

Since CM is a perpendicular on the produced base of the triangle HLC, therefore the area of that triangle is $\frac{HL \times CM}{2}$ or $\frac{x \times z}{2}$.

But the triangle HGC is clearly equal to the triangle HLC, therefore the area of $HGC = \frac{x \times z}{2}$, that is to say the width of the road multiplied by the height above the ground at which the bamboo cuts the staff, divided by 2, gives the true sectional area of the cross-section including the slope that has to be given to the side of the road.

Assuming that the alignment has been properly marked on the road, it will not be necessary to put a peg in at point C, except for the purpose of being able to check the work, but it is useful to put in a peg at the point H, as this will mark the limit of the excavation.

The detail thus collected can be entered in a form such as the following :—

No. of cross-section.	Distance from last cross-section.	Width of road.	*Area of cross-section.* Width × height = / 2	Wh / 2	Volume.	Rate per 1,000 c. ft.	Cost. Rs. a. p.	Remarks.
2	100′	X′	$\frac{X' \times Z'}{2}$	$\frac{X'Z'}{2}$	50X′Z′	Rs. 5	*a. b. c.*	Earth.

In order to calculate the exact amount of material to be removed in any strip of cutting, it would of course be necessary to multiply the length of the strip by the *mean* of the areas of the cross sections at either end. This would however complicate the table too much, and sufficiently accurate results are obtained by multiplying the length of the strip by the area of the cross-section at one end, especially if the cross-sections have been taken at fairly regular intervals. The result thus arrived at would not, of course, be accurate in the case of one strip only,

but the result for a large number of strips is as accurate as is necessary for rough estimates of this character.

Any other details, such as the estimated cost of blasting, can be entered in this table, and if the work is carefully done the total cost arrived at should be a fairly accurate estimate of the work.

I have written this note merely to introduce to the notice of Forest Officers who are unacquainted with it the road-estimating instrument above described, without in any way giving it as my opinion that this instrument provides the best way of making rough estimates. Opinions may differ on this point, and indeed I am aware that many practical Forest Officers prefer not to take side-slope into consideration at all; they prefer to cut the side of the road as nearly prependicular as possible, and to allow the soil to assume its natural angle of repose gradually, falls of earth from the side being cleared away as they occur. Another way would of course be to make the estimates with two simple bamboos according to the first method described above, and to add to the estimated number of cubic feet of cutting a certain percentage to cover the extra volume removable if side slope is taken into consideration.

It will of course have been noticed that in drawing the diagrams, and in making calculations therefrom, the slope of the ground within the parallelogram has been taken as absolutely uniform, and has been represented by a straight line. This would of course not usually be the case in practice, for slopes are generally uneven, being more or less concave in some parts and convex in others. It might very likely be the case that over a considerable length of alignment the concavity and convexity at various points would about balance each other, in which case it would probably be considered unnecessary to pay any attention to the variation in the shape of the slope in what, after all, are only rough estimates.

If however it were decided to take into consideration the unevenness of the slope, the area of each cross-section might be calculated as follows. As explained above, the area of a cross-section in cases where the slope is uniform is $Ar \times \frac{1}{2}$ (*vide* Fig.

1), or $xy \times \cdot 5$. In places where the slope becomes convex the area of the cross-section will be greater, and the factor of multiplication will have to be increased ; that is to say xy will have to be multiplied by ·6, ·7, or in extreme cases ·9. Where, on the other hand, the slope becomes concave, the multiplying factor will have to be reduced. This factor must be estimated by eye. Fig. 5 explains roughly what is meant.

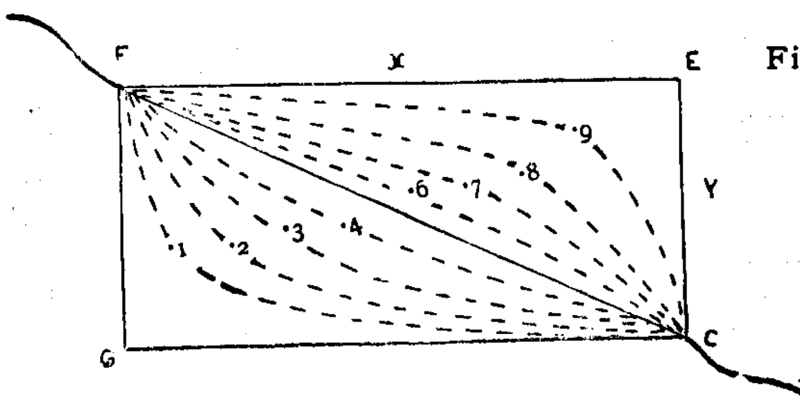


Fig. 5*

Here FC represents slope of the hill within the parallelogram as in Fig. 1, and x and y are the two measurements obtained by the bamboos as explained in the case of Fig. 1. If FC is a perfectly uniform slope then the area of the cross-section FGC will be $xy \times \cdot 5$. If, however, the position of FC is as one of the dotted lines, or, in other words, if the slope is concave or convex, then the area will be found by multiplying xy by ·4, ·7, or whatever the multiplying factor is estimated to be. The same principle can of course be applied when the road estimating instrument is used, and in the case of Fig. 4 if the slope HC was not uniform xy could be multiplied by something more or less than ·5 according to the circumstances of the case.

For an explanation of this method of calculating the areas of cross-sections where the slope is not uniform, I am indebted to

* This figure is not geometrically accurate as far as the dotted lines are concerned.

Mr. R. S. Hole, who tells me that he saw Mr. W. H. Lovegrove carrying out this method in practice in the Ganges Division of the United Provinces some years ago.

J. D. MAITLAND-KIRWAN,
I.F.S.

NATURAL EXTENSION OF *SUNDRI* AREAS IN THE SUNDERBANS.

In many places in the Sunderbans considerable areas carrying good growth of the valuable Sundri (*Heritiera minor*) are being gradually washed away by the action of the rivers. This, however is not such a serious loss as it would appear to be at first sight, inasmuch as new areas are continually being formed which are soon covered with vegetation of light-demanding species, the latter being eventually replaced by *Sundri.*

Formation of new lands.—New areas are formed in two ways :—

(*i*) by gradual addition to existing areas,

(*ii*) by formation of new islands.

The land so formed consists of deposits from the running water which holds vast quantities of fine clay in suspension.

(*i*) Additions to existing areas always take place at the bends of the rivers. Water running round a bend gets its velocity checked on the inner side and therefore it cannot hold all the suspended clay it was carrying before, part of which is consequently deposited. While new land is thus being added to the inner bank, the outer bank being subjected to the action of water running at high velocity is gradually washed away. (See Fig. 1.)

(*ii*) The formation of new islands is due to a similar cause. When the currents of two rivers flowing from different directions meet together the velocity of the water is checked and a deposition of suspended matter takes place so that new land is gradually formed at the junction. (See Fig 2.)

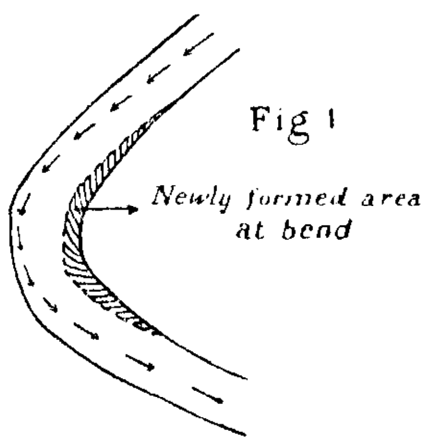
A fine example of a newly-formed island like this can be seen at the junction of the Marjat and the Sipsah rivers.

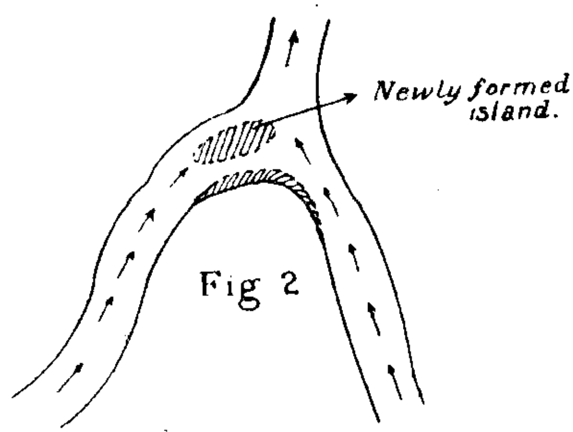
Plant-growth on new lands.—When areas formed in the two ways mentioned above are sufficiently elevated to be well above water-level at ebb-tide they soon acquire a covering of vegetation. The first arrival is grass, which helps to catch more sediment and thus accelerates the elevation of the areas which it occupies. The species to come next are the strong light-demanders, namely, *Ora* (Sonneratia acida), *Goray* (Kandelia Rheedii), *Keora* (Sonneratia apetala), *Khalsi* (Ægiceras majus) and *Gol patta* (Nipa fruticans). When these areas rise so high that they are never flooded except by the spring-tide floods, *Gewa* (Excoecaria Agallocha) springs up. This *Gewa*, though very light-demanding, cannot grow on the low areas where *Ora*, *Keora* or *Goray* thrive well and which are under water for about twelve hours every day, for the reason that *Gewa* roots do not give out *Shoolas* (which are the organs of respiration for the roots).

Finally, under the shade of these light-demanding species, *Sundri* appears which requires shade in its early stages of development. Now *Keora* and *Gewa*, etc., being strong light-demanders, soon thin out naturally and gradually set free the *Sundri* crops beneath them. Thus within a comparatively short time new pure *Sundri* areas are formed where there was no land before.

Once formed these *Sundri* areas will continue, provided they are not devastated artificially by reckless fellings, or by natural

calamities (of which fortunately there is only one in the Sunderbans, namely, the Cyclone).





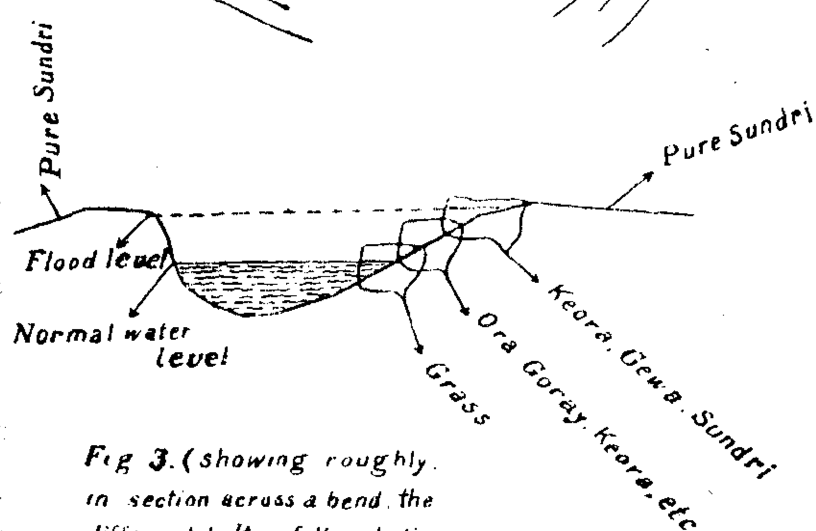


Fig 3. (showing roughly in section across a bend the different belts of Vegetation at different levels.)

R. C. Bhattacharyya,
Forest Ranger.

Sunderbans. 3·8·13.

Carter's Timber Tables, 2nd edition.—By F. A. LEETE, Esq., I.F.S.

We have received a second edition of Carter's Volume Tables which has been compiled by Mr. Leete. The new edition contains several important additions and alterations and is printed on superior paper to that of the original. The size has been increased from $4\frac{1}{2}'' \times 9\frac{1}{2}''$ with 27 pages of the first edition to $8\frac{1}{4}'' \times 13\frac{1}{2}''$ with 47 pages. We cannot congratulate the author on the increase in size and should have preferred the book being kept to pocket size, even at the cost of considerably increasing its thickness. As regards reduction in breadth, this could be done by restricting a page to six columns in Table I, reducing the breadth of the spacing and possibly also number of columns per page in Tables II and III and by halving the columns per page in Table IV. To overcome the difficulty in the length of the book, the spaces between each set of three figures might with advantage be closed up, a thin line being added instead, and length readings of logs below 10 ft. might commence at 5 ft. instead of at $\frac{1}{2}$ ft.

The most important addition made to Table I is that girth readings have been added from 10′ 11″ to 13′ 11″ and readings for logs of under 10 ft. and over 50 ft. length. Such data without doubt enhance the value of the publication, especially those figures relating to logs of over 50 ft. in length and above 11 ft. in girth. It is, however, open to doubt whether readings for lengths of $\frac{1}{2}$ ft. to 5 ft. are of sufficient value to find place in the tables. Another important addition to this table is the insertion at the top of the page of measurements for converted material, of equal sides, which enable one to read off directly from the Round Timber measurements the corresponding volumes of squared timber. This is an ingenious idea and one of considerable value, though it at once recalls to one's mind the inaccuracy of the quarter-girth system of calculation.

On page 16 is given (in a clearer way than was done in the former edition) a resumé of volumes of exceptional-sized logs from 14' to 20 ft. in girth.

Table II is entirely new. It deals with squared timber, in combination of inches and half inches up to the size of $5\frac{1}{2}$ inches, after which the units shown are full inches only. This forms a useful addition to the Tables and has been drawn up in a compact and convenient form, the only difficulty being to ascertain without unnecessary delay where to look for the column in which to find any given size of irregular-sided square. To overcome this difficulty we would suggest a small reference key at the commencement of the tables.

Table No. III deals with railway sleepers and we have nothing but good to say about it.

Table IV enables one to obtain the number of running feet of any given sized scantling or board required to make up a ton of 50 c.ft. of timber. This table is useful, though we rather doubt the value of taking the breadth readings beyond 20 inches. Like the data for volumes of converted material given in Table II, this table will probably be found of greater use to the Saw-Mill manager, timber merchant and shipper than to the Forest Officer, who generally has to deal with timber in the round.

On the whole, we think that the 2nd edition of Carter's Tables is a great improvement on the 1st edition, although its value would have been enhanced had the size of the book been reduced so as to fit the pocket—a point of considerable importance in the case of such tables which are generally used in the forest or in depôts rather than at the desk.

Mr. Leete has also issued a small, very handy and compact pocket-book, entitled "Pocket Timber Tables." This booklet, published by the British Burma Press, contains two charts, one for Round and another for Squared Timber, from which the volume corresponding to dimensions can be easily ascertained. The idea of the charts is excellent, the only drawback to them being that they are too small to enable one to read accurately to inches in girth and the corresponding volume. How best to

overcome this difficulty, without increasing the size of the book, is not easy to suggest. We rather favour lengthening the book to 9 inches, *i.e.*, adopting the length of the 1st edition of Carter's Tables, keeping the present breadth, and introducing considerably larger charts for Round and Squared Timber, printed on stiff paper or on paper backed by linen, which might be folded in a pocket at the end of the book.

The tables for Round and Squared Timber given, though a little complicated to work at first, are compact and all that is required. The Table of " Running feet to the ton " is simple and easy to work, while many useful memoranda are given on pages 26 and 27 of the pocket-book.

LOCAL FOREST FLORAS IN INDIA.

With reference to the opinion expressed on pages 545—552 of our Volume No. XXXVII regarding the advisability of drawing a distinction between *Floras* and *Descriptive Lists* and of first undertaking the systematic preparation of *Descriptive Lists*, we note that this subject has been dealt with as follows by the Board of Forestry which met at Dehra Dun in March last in their Resolution No. XIV:

"Previous to the meeting of the Board, all Local Governments (except Bombay) were addressed by the Government of India, regarding the preparation of forest floras and were asked to compile descriptive lists as a preliminary step. The Board considered the replies to this reference, and a note on the subject (Extract,

* *Note.*—The greater liability of certain animals to injury may possibly be due to the fact that the prussic acid does not exist ready-made, as it were, in the plant tissues but is generated by the interaction of a glucoside and a ferment which occur in the plant tissues and which are brought in contact when these tissues are chewed. This interaction would tend to be more complete, the slower and more thorough the chewing.—(HON. ED.)

Appendix F), compiled by the Forest Botanist, who was present. In the discussion which took place, Mr. Lace and other members of the Board expressed the opinion that descriptive lists, such as those proposed, would ordinarily be sufficient and were certainly as much as a forest officer should be expected to prepare. The writing of a complete forest flora was, in their opinion, work for a specialist in Botany. It was agreed that descriptive lists were urgently required, but a considerable difference of opinion was shown as to the areas to which such lists should apply. It was held by some members that the multiplication of lists would lead to unnecessary duplication of work, which might be a greater disadvantage than the elaboration of the keys which would arise from the inclusion in a single list of a large number of species, but on the whole the desirability of preparing the lists with simple keys was admitted. The following resolution was recorded :—

The Board considers—

(i) That detailed forest floras are useful for purposes of reference and that their ultimate publication is an object which should be kept steadily in view.

(ii) That the preparation of detailed floras is not of such urgent importance at the present time as is the preparation of descriptive lists.

(iii) That the scope and general character of the descriptive lists, as detailed in paragraph 2 of Mr. Hole's note and in Sub-Appendices I, II, IV and V with schedule thereto, are generally suitable.

(iv) That the preparation of descriptive lists should be undertaken in the various provinces as soon as circumstances permit.

(v) That it is desirable that the preparation of the lists should, as far as possible, be undertaken on uniform lines in all provinces.

(vi) That the precise area to which each list should apply should be decided by Chief Conservators and Conservators in consultation with the Forest Botanist, subject always to the approval of the Local Government.

(vii) That specimens of all species collected by officers who work on these lists and floras should be placed permanently on record in the Dehra Dun herbarium."

On this Resolution the Government of India has recently passed the following orders :—

"*Resolution No. XIV: Preparation of local floras.*—In their circular No. 20-F.-105-6, dated the 30th September 1912, the Government of India stated that they considered it very important that the preparation of local forest floras should be taken in hand at an early date, and requested Local Governments to favour them with their views as to the steps to be taken to ensure the early preparation of preliminary descriptive lists. The whole question, together with the opinions received from Local Governments, was then referred to the Board of Forestry for opinion. The Board discussed the matter fully, and their conclusions are given in the Resolution under reference. The Government of India have considered this Resolution with care, and agree that the preparation of descriptive lists in accordance with Appendix F to the proceedings of the Board will ordinarily be sufficient for present practical requirements and is the first step to be taken. They therefore accept this Resolution generally, and trust that Local Governments will now undertake the preparation of descriptive lists on the lines referred to in parts (iii) and (vi) thereof. They desire, also, to invite attention to the remarks in paragraphs 6 and 7 of Mr. Hole's note (Appendix F) regarding the necessity for supervision by Conservators and co-operation with the Research Institute in preparing the descriptive lists. The questions of the manner in which, the agency by which, and the areas for which, floras should be prepared will be decided after the descriptive lists have been completed. Each Local Government will, if necessary, be addressed separately on questions of detail with reference to its reply to the circular of 30th September 1912 referred to above."

[We understand that the detailed note in question, giving the scope of the descriptive lists, is being separately published and will be distributed to local forest officers for information.—HONY. ED.]

IMPORTED SLEEPERS.

In the last journal of the Permanent-way Institute of India is a note on Creopine sleepers which states that though the sleepers are first delivered from their forests on the Baltic in England, creosoted there and then sent out to India, their cost at Karachi is less than the cost of an untreated sleeper of deodar at Wazirabad, the actual figures being Rs. 3-6-6 and Rs. 3-12-0 respectively. The statement is so surprising, that it is worth a special enquiry, the point to investigate being that admitting the price of Rs. 3-6-6 was actually paid, is that the genuine cost of the sleeper, leaving a fair margin of profit to the supplier? The extraordinary part of the history of these sleepers is that the first lot supplied proved excellent and the last lot turned out a total failure. It is not an unknown thing in trade to advisedly suffer a loss at first in order to establish a business, and once the business is established either to raise prices or to supply an inferior article. Fifty miles of creosoted pine (creopine) sleepers from the Baltic laid near Hyderabad, Sind, in 1896 lasted 15 years, and 15 miles laid near Sukkur in the following year also lasted 15 years. But when in 1905 five miles were laid near Multan their life was found to be only seven years. The last lot were deficient in weight, the creosote had penetrated only ¼ inch, the sleepers were of some inferior pine and cut from small trees and a large number were cracked before being put into the road. The reason given (we cannot say if it was accepted) for the inferiority of this last lot was that they were supplied in a hurry, which is no excuse at all. If a red pine sleeper can be sent from the Baltic to England, undergo there a most rigorous selection (*vide* the specification quoted in the journal), undergo next a rigorous preservative treatment and then be re-shipped to Karachi, a port nearly 6,000 miles distant, to be sold there at a price less than that of an Indian sleeper cut in the hills and landed on the railway just outside the hills, it certainly seems as if the price of the latter is ridiculously high or the price of the former is fictitious.—[*Indian Engineering.*]

AUCTION SALES OF SANDALWOOD IN THE MYSORE STATE.

(*Extracts from the Proceedings of His Highness the Maharaja of Mysore.*)

READ—

The following letter No. 6157, dated the 4th February 1913, from the Conservator of Forests in Mysore, reporting on the result of the auction sales of sandalwood in the several depôts of the State in November and December 1912.

I have the honour to submit my Report on the Auction Sales of Sandalwood for the year 1912-13, for the information of Government.

2. The sales were commenced this year in the Mysore District and continued in the other districts in the order given below:—

District.	Koti.	Date of sale.
1	2	3
Mysore	Hunsur	18th November 1912.
Do.	Seringapatam ...	21st do.
Bangalore	Bangalore	25th do.
Hassan	Hassan	28th do.
Kadur	Chikmagalur	2nd December 1912.
Do.	Tarikere	5th do.
Shimoga	Shimoga	9th do.
Do.	Sagar	12th do.
Do.	Tirthahalli	16th do.

3. The total quantity of sandalwood exposed for sale in all the Kotis was a little over 2,407 tons and the whole was sold off readily. The following statement gives the quantities sold and the amount realised in each Koti :—

District.	Koti.	Auction sales. Quantity.	Auction sales. Amount.
1	2	3	4
		Tons. cwt. lbs.	Rs. a. p.
Mysore	Hunsur	450 4 28	3,13,038 15 7
Do.	Seringapatam ...	278 16 87	1,99,650 8 4
Bangalore	Bangalore	125 0 0	1,08,676 13 8
Hassan	Hassan	151 4 98	1,38,933 4 0
Kadur	Chikmagalur ...	250 0 0	2,55,913 7 3
Do.	Tarikere	325 0 56	3,46,185 4 6
Shimoga	Shimoga	501 15 0	5,59,879 10 5
Do.	Sagar	100 15 0	1,04,447 0 5
Do.	Tirthahalli	225 0 0	2,36,451 0 3
	Total ..	2,407 16 45	22,63,176 0 5

4. The gathering of purchasers was large at all the Kotis, except at Sagar, where there were only four—of whom, it would appear, only three competed. The competition was very keen and bidding very brisk throughout, so much so that the Indian merchants had no chance against their European rivals. The result, therefore, was very satisfactory from a financial point of view. High rates ruled right through. They rose from Koti to Koti as sales progressed and reached a climax in the Shimoga Koti. Afterwards, there was a slight fall in the Sagar and Tirthahalli Kotis due to the withdrawal of the Indian merchants

who, feeling disappointed and depressed at the turn the sales had taken, abstained from attending these Kotis. I hesitate to express an opinion on the effect of these high rates on the sandalwood-oil market, but it seems impossible to view the future with equanimity. There is good reason to fear that they will be followed by a limited demand, or the replacement of sandalwood-oil by some other cheaper ingredient. Of one thing we may be certain, and that is they will compel the Indian merchants to close down their distilleries.

5. Compared with the figures of the past year, the quantity offered for sale and sold exceeded by tons 59-14-63.

6. The result of the sales during the current year as compared with that of the previous year at the several Kotis is shown in the subjoined statement :—

District.	Koti.	Quantity exposed for sale.		Quantity sold.	
		1912	1911	1912	1911
1	2	3	4	5	6
		Tons cwt. lbs.	Tons cwt. lbs.	Tons cwt. lbs.	Tons cwt. lbs.
Mysore ...	Hunsur ...	450 4 28	500 3 56	450 4 28	500 3 56
Do. ...	Seringapatam	278 16 87	275 1 14	278 16 87	275 1 14
Bangalore ...	Bangalore ...	125 0 0	120 1 66	125 0 0	120 1 66
Hassan ...	Hassan ...	151 4 98	152 1 49	151 4 98	152 1 49
Kadur ...	Chikmagalur...	250 0 0	250 0 0	250 0 0	250 0 0
Do. ...	Tarikere ...	325 0 56	250 0 0	325 0 56	250 0 0
Shimoga ...	Shimoga ...	501 15 0	475 4 56	501 15 0	475 4 56
Do. ...	Sagar ...	100 15 0	100 9 77	100 15 0	100 9 77
Do. ...	Tirthahalli ...	225 0 0	225 0 0	225 0 0	225 0 0
	Total ...	2,407 16 45	2,348 1 94	2,407 16 45	2,348 1 94

District.	Koti.	Amount realised.						Average rate per ton.	
		1912			1911			1912	1911
1	2	7			8			9	10
		Rs.	a.	p.	Rs.	a.	p.	Rs.	Rs.
Mysore ...	Hunsur ...	3,13,038	15	7	2,86,441	2	10	695	573
Do. ...	Seringapatam ...	1,99,650	8	4	1,51,545	10	3	715	550
Bangalore ...	Bangalore ...	1,08,676	13	8	68,866	2	0	869	573
Hassan ...	Hassan ...	1,38,933	4	0	83,629	13	6	919	550
Kadur ...	Chikmagalur ...	2,55,913	7	3	1,36,742	3	7	1,024	547
Do ...	Tarikere ...	3,46,185	4	6	1,29,446	8	0	1,065	517
Shimoga ...	Shimoga ...	5,59,879	10	5	2,46,929	6	4	1,115	518
Do. ...	Sagar ...	1,04,447	0	5	43,573	9	0	1,037	435
Do. ...	Tirthahalli ...	2,36,451	0	3	1,06,980	13	7	1,051	475
	Total ...	22,63,176	0	5	12,54,155	5	1	940	534

7. The realisation was Rs. 10,09,020-11-4 in excess of that of the previous year.

* * * *

15. The names of the buyers, the quantity purchased by each, and the value thereof are given below :—

No.	Name of firm or merchant.	Quantity of sandal-wood purchased in 1912.	Sale amount. 1912			Sale amount. 1911		
		Tons cwt. lbs.	Rs.	a.	p.	Rs.	a.	p.
1	Messrs. Volkart Brothers	1,316 17 59	12,31,952	8	10	5,35,444	7	4
2	,, Pierce Leslie & Co.	526 18 56	5,11,334	15	8	1,43,264	7	1
3	,, Sorabji Nowroji & Co.	287 9 7	2,54,910	9	10	1,74,205	2	2
4	Mr. Benarisi Das Haridini Lal.	62 3 84	70,349	6	9	46,020	2	7
5	Mr. Makhulal Ayodhya Prasad.	36 0 0	38,461	14	5	16,356	9	0
6	Mr. Manamlal Shungulam Das.	35 5 0	38,289	8	0	...		
7	Mr. Hafiz Ameerudin ...	41 18 28	36,485	14	9	23,630	9	3
8	Mr. Makhunlal Chain Sukh Das.	36 0 0	30,233	0	0	72,957	11	3
9	The Kashmiri Bank, Ltd.	31 0 0	25,144	0	0	50,622	10	0
10	Mr. Mahomed Makkiseth	12 0 0	8,946	0	0	15,059	8	0
11	Sowcar Gunda Setti of Hassan.	9 13 0	7,176	0	0	1,16,506	6	5
12	Mr. Marthappa Kini ...	8 10 0	6,553	8	0	20,887	8	0
13	Mr. Hafiz Abdul Karim	1 15 0	1,522	8	0	11,201	0	10
14	Mr Santharajaiya Adhikari.	0 15 56	664	15	2	1,012	8	0
15	Mr. Ramannah Heggade	0 14 0	630	0	0	3,597	0	0
16	Mr. Manjanath Pai ...	0 16 91	521	3	0	...		
	Other petty merchants...	...	...			23,389	11	2
	Total ..	2,407 16 45	22,63,176	0	5	12,54,155	5	1

16. Messrs. Volkart Brothers of Tellicherry purchased more than half the out-put, Messrs. Pierce Leslie & Co., 22 per cent. and Messrs. Sorabji Nowroji & Co. of Bombay, 12 per cent., leaving less than 12 per cent. for some 20 Indian merchants, many of whom are dependent on this trade alone.

17. The budget provision under sandalwood for the year 1912-13 is Rs. 10,75,000 and the actual realisation exceeds this by Rs. 11,88,176.

18. The total quantity of private sandalwood sold along with the wood of the State during the year was tons 6-6-0 against tons 5-11-4 in the previous year and the amount realised was Rs. 5.874-11-5.

No. R. 7377-87—Ft. 37-12-18, dated Bangalore, 5th June 1913.

ORDER THEREON.—The prices realised during the year were the highest on record. Although the quantity of sandalwood exposed for sale, *viz.*, 2,408 tons was but slightly in excess of the quantity exposed in the previous year, the total realisations were more than ten lakhs in excess of the previous year, and amounted to Rs. 22,63,176. The all-round average rate fetched was Rs. 940 per ton against Rs. 534 in the previous year.

2. Government observe that the Conservator himself entertains doubts as to whether the present high level of prices will continue and apprehends that it may affect the demand by leading to the use of cheaper substitutes. As the question is important, the Conservator is requested to investigate the matter thoroughly in consultation with the Director of Industries and Commerce and submit proposals as to the measures necessary to enable Government to derive the fullest benefit from the existing monopoly.

K. R. SRINIVASIENGAR,
Secy. to Govt., Gen. & Rev. Depts.

THE MATCH INDUSTRY.

A note on the prospects of establishing a match factory in Southern India which is published in the current issue of the *Travancore Government Gazette*, gives an account of the further advance made in the work of finding a suitable wood for making matches and boxes. Samples of one hundred and twelve species of Travancore woods were sent to "The Karnatak Match Factory" at Dharwar, the proprietor of which, Mr. R. V. Alagwadi, very kindly undertook to test the woods and to send samples of outturn and a report, free of any charge. This he has since done, forwarding six sample boxes and splints of each species tested and a detailed report on the quality and suitability of the woods. From his report we see that out of the 112 samples of woods sent, one was found to be a duplicate and three others reached the factory in a condition unsuitable for testing. Of the remaining 109 species 42 have been found to be suitable for splints and boxes—18 of them being found very good, 22 of the others are suitable for boxes only and one for splints only, while all the other 44 have been found to be unsuitable. If to the 42 species which now are found to be suitable for splints and boxes are added the 18 others occurring in Travancore and previously ascertained to be suitable for the purpose, the total number of the soft-wooded species fit for match-making (both boxes and splints) comes to 60. Omitting from consideration other soft woods found in the State forests and still remaining to be tested, it may now be safely stated that the 60 species already tested and pronounced suitable are sufficiently abundant both in quality and quantity to justify the starting of one or more match factories in the State with every assurance of a profitable business.—[*Commerce.*]

THE RÜPING PROCESS OF CREOSOTING TIMBER.

The Controller of the Stores Department of the General Post Office, London (Mr. G. Morgan, I.S.O.), has been good enough to inform the Editor that for the purposes of experiment on a fairly large scale, his Department has recently arranged that, in those yards where the Post Office contractors have set up the necessary plant, all telegraph poles of the light and medium classes, together with those of the stout class which are 50 feet or upwards in length, will be treated by the Rüping process ; but stout poles under 50 feet in length, which are used to carry the main trunk lines, will, for the present, continue to be treated by the old process.

The Rüpingising of timber has been widely practised both on the European continent and in America. The process was adopted in Germany some eight or nine years ago, and has been largely extended there, year by year, with all present appearance of efficacy. In the United Kingdom creosote oil is relatively cheap, and the economy in its use resulting from the newer process is therefore of less importance than it is in continental Europe and America.

Messrs. Burt, Boulton and Haywood, Ltd., of Victoria Docks, London ; Messrs. Richard Wade, Sons and Company, of Hull ; and Messrs. Corry and Company, Belfast, are believed to be, at present, the only firms who have installed Rüpingising plant in their yards.

Messrs. Wade have favoured the Editor with the following brief description of the process :—

" The Rüping process of creosoting consists in subjecting the timber to be preserved to an air pressure of 50 or 60 lbs., after it has been placed and sealed up in the impregnating cylinder. Then, *whilst maintaining the air pressure*, the creosote, at a temperature of about 100° to 140°, is admitted to the cylinder from an overhead storage tank, and the pressure is then increased to 70 or 80 or 100 lbs. (or whatever may be necessary according to the texture of the timber). After the desired pressure has been reached, it is taken off, either immediately or after a few minutes,

and the oil is returned to the overhead tank. After this the impregnating cylinder is opened and the timber is found thoroughly penetrated by the creosote, but perfectly dry and clean, the air pressure inside the timber having opened up the pores of the wood to admit the oil, and having then driven out the superfluous oil from the interior of the pores of the timber and left only enough to impregnate the walls of the cells, which is quite sufficient for preserving them."

The aim is to saturate thoroughly the wood-fibre with the preserving liquid, without leaving any of it in the open spaces which these enclose, the result being that a smaller quantity of liquid is required than under the ordinary process. It is claimed that a deeper penetration is obtained, while the timber is left so clean and dry that it can be handled immediately after its removal from the cylinder, and can be painted after it has been in use for some time.

The advantages gained by the process are thus summarised:—

(1) A thorough saturation of the whole of that portion of the timber which can be saturated by the preserving *liquid.*

(2) The absorption of only so much liquid as is necessary to accomplish this.

(3) The oozing and sweating of wood is completely prevented, the timber being dry and clean.

(4) A great saving in cost without reducing the life of the timber.

The results of the process have been tested by Professor Baron von Tubeuf, of the Munich University, who has reported very favourably on it. Specimens of Rüpingised wood may now be seen at our Secretary's Office, 19, Castle Street, Edinburgh.—[Extract from the *Transactions of Royal Scottish Arboricultural Society.*]

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SYLVICULTURAL SYSTEMS OF REGENERATION IN CHIR PINE FORESTS.

The Chir Pine Forests of the Himalayas have, in different districts, and under various Working-Plans, been treated under a variety of different systems; Pure Selection, Selection-in-Groups, the Shelterwood Compartment System (or Uniform Method) have all had a more or less extensive trial in the United Provinces and Punjab, while the Group System in Periodic blocks is, I believe, about to be introduced in the Punjab. The object of this paper is to try and crystallise the results of experience we have gained, to focus attention on the problems that confront us, and to suggest, in all humility, the most suitable system or systems for the management of our Chir Pine Forests. With the results of a quarter of a century's management before us, we should surely attempt to come to some conclusions on this most important point.

In considering a question of this nature, it seems a logical procedure, first to observe and record various phases of chir reproduction, natural and artificial; second to examine how and

why the various systems tried in the past have succeeded or failed; third to draw what conclusions we can to guide us in the future management of these forests.

I.—OBSERVATIONS ON CHIR PINE REPRODUCTION.

To show what an accommodating tree the chir is, and to what extent success can be obtained under unfavourable conditions, I would quote the example of the well-known plantations at Almora. These plantations were commenced in 1875. The area taken up was a dry and barren hill top, denuded of all forest growth, with a wretched mica-schist soil, and hot south and east aspect. The elevation, varying from 5,600′ to 6,400′, was at the upper limit of chir growth.

Chir seed was sown in pits, and the area was afforded the advantages of fire-protection, and freedom from grazing, and from removal of humus. Mr. Troup, Forest Sylviculturist, formed sample plots and took measurements in these plantations, and the following data are from his notes :—

Age of crop, years.	Mean girth inches.	Mean height feet.	No. of stems per acre.	Total volume solid c.ft.	M. A. I. c.ft.	REMARKS.
36	17·3	31	820	1,786	49·6	S. aspect poor quality.
36	24·8	47	436	2,386	69·0	
23	19·9	29	560	1,528	66·5	
19	15·3	27	980	1,436	75·6	Excluding suppressed trees.

This rate of growth is at least equal to the natural young pole forests on the same mica-schist formation, although inferior to the best natural growth on the tertiary sandstone formation.

When we come to study the natural reproduction of chir, there are two points which most forcibly bring themselves to our notice. The first is regarding the seed-bearing powers of immature trees. In the Punjab exhaustive qualitative experiments have been carried out, which show that the seed from immature

trees is fertile, and has a high germinating percentage, but I have never yet seen or heard of any quantitative experiments on these lines, which to me appears at least as important a line of enquiry.

For successful natural regeneration, it is an obvious truism that enormous quantities of seed are necessary, first to satisfy the birds and beasts that feed on the seed, and generally to make up the waste that occurs in Nature, and then to form the abundant masses of young plants. If immature trees produce inadequate quantities of seed, it seems useless to consider whether the seed is fertile or not, in any case natural regeneration would be a failure.

As I know of no experiments to support me, I must fall back on the results of observation. I have had the opportunity of seeing two heavy seed years of chir pine. In good seed years, almost every mature tree is loaded with cones. Immature trees, on the other hand, rarely have more than a few cones, and frequently none at all. Not one immature tree in a thousand will be found loaded with cones, as are the mature trees.

I would specify exactly what I mean by mature and immature trees. A girth-class is no criterion. One may see long lanky trees of 3′ girth, trees which have been suppressed all their lives, and which have been ignored by timber contractors and left standing solitary, with their diminutive and misshapen crowns loaded with cones, while near by dominant trees of 5′ and even 6′ girth, still in the full vigour of their height growth show no cones at all. No. by mature I mean trees which have completed their height growth, and have become (or are becoming) umbrella-shaped, while an immature tree is one that is still shaped like a spear.

This leads us to the next point. Our chir pine forests most frequently occur in more or less even-aged groups of variable extent. The groups may vary in size from a few trees to several acres, but really extensive areas (say, 400 or 500 acres) of even-aged forest are occasionally to be met with. It will be found that, given sufficient protection, natural regeneration will spring up under the groups of mature and overmature trees, but will not be found under the groups of immature trees. This may be put down to

absence of sufficient light, or absence of sufficient seed, or both causes may be operating. But personally I think (for reasons that will be discussed hereafter) that it is the latter cause which is chiefly responsible for the absence of reproduction.

On the other hand, nothing will stop the regeneration springing up under the mature groups, except fire (and possibly excessive grazing, of which I have no experience).

There are one or two other points which might be touched on before leaving the subject of chir reproduction.

Three years ago I sent a quantity of chir seed to the Executive Engineer, Maymyo, Burma. He informed me recently that they had germinated well, but refused to grow to any extent. This is scarcely surprising. The Naini Tal Working-Plans state that it takes fifteen years for a chir seedling to establish itself, before it begins to put on any rapid height growth. Fifteen years is possibly over the mark, but it certainly takes a long time before a chir seedling reaches 3′ in height. This is a point to be remembered in fixing the regeneration period.

The intense light-demanding nature of the chir is too well known to require comment, and the Almora plantations prove how well it will grow when sown in the open. Nevertheless the shade of a mature chir forest, as we find it at present, is never sufficient to stop the young seedlings from springing up and establishing themselves, although their further development is undoubtedly checked unless they are completely freed of overhead cover.

One hears a good deal nowadays of "preparatory fellings" for the Himalayan coniferous forests. These would, I am convinced, be unnecessary for the chir. The light-demanding nature of the tree ensures that when an area has become mature, and is ready for regeneration, it will have thinned itself out, and become sufficiently open, to allow the crowns to be properly developed, and to allow the ground to be in the nature of a seed-bed.

The forests around Ranikhet and Almora afford a most interesting comparison of the powers of reproduction of the three chief species of Himalayan conifers, the Kail (*Pinus excelsa*),

Deodar (*Cedrus deodara*) and Chir (*Pinus longifolia*) in their immature state. Extensive plantations were made in 1875-76 of all three species, in areas where they were not previously found. These plantations are thus 37 years old now. Around the Kail areas we find quantities of young Kail springing up, some of the young plants are now 15 or 16 years old, and are beginning to bear cones themselves. Around the Deodar areas we find fair quantities of young seedlings just beginning to appear. In or around the Chir plantations, there is not a seedling to be seen. I have never so much as seen a cone on the trees. However this is somewhat of a digression, and I will turn to the next point for examination.

II.—The results of past methods of working.

As has been indicated above, the chief methods which have been adopted in the past were Selection, or Selection-in-Groups and the Uniform Methods. The chir forests around Naini Tal have been managed under Working-Plans on the Selection System for over 25 years, and the forests around Ranikhet on the Uniform System for the same period. There are several instructive lessons to be noted by a comparison of these two areas.

There are three factors which influence the annual coupe: area, number of trees, and sylviculture, and the greatest of these is sylviculture. One may fell a fixed area by sylvicultural rules and obtain a fluctuating yield; or one may fix the annual yield and mark the trees where sylviculturally available, over a variable area. But if one fixes the annual yield over a fixed area, there is no scope left for sylviculture. Unfortunately both the Naini Tal and Ranikhet Working-Plans adopted the last alternative, and in a comparison of the two systems it is difficult to eliminate entirely the results of this unfortunate choice.

The Selection System, from the very nature of the forests, was usually forced into the Selection-in-Group System. But both theoretically and in practice, either system is unsuitable for chir. In the mature groups over regeneration, the large trees are taken out, and the suppressed trees, with no future before them, and frequently with no possibility of becoming an exploitable

size, were left to hinder and damage the group of young regeneration.

Again, when one does have an extensive area of even-aged forest, it is folly to try and treat it under a Selection System. It will refuse to reproduce until it is mature, and ready to do so, and then it will reproduce wholesale, the old trees will die off, and the next rotation will remain even-aged. In such an area it is impossible to keep a proper distribution of the age-classes. An excellent example of this may be seen near Naini Tal. In 1896 there were 3,600 trees over 4′ 6″ girth. From 1896—1899 about 1,700 of these were felled. Since then some have died off naturally, and 1,400 now survive. These survivors are all over-mature, and are now being tapped to death (for resin), preparatory to being felled in five years' time. The whole forest is densely stocked with superb regeneration up to 30′ high, and nothing will be available for felling (except thinnings) for another century.

But when one has a light-demanding gregarious species, such as the chir, which is seen at its best in even-aged crops, and which demands some form of regular intensive management, it is useless to argue against a Selection System; one would have no one to argue with.

Let us turn to an examination of the Uniform System, as exemplified in the Ranikhet forests. In each Working Circle* one-eighth of the area was put in Periodic block I, and regeneration fellings were commenced. Three fellings were prescribed, a 1st, 2nd and final felling, at intervals of ten years in some areas and seven years in other areas. There are in all ten regeneration areas, in some of which final fellings have been completed, and in some they are shortly to be carried out.

One is forcibly struck with magnificent success in some areas, and abject failure in other areas. One morning an area is inspected which calls up vivid memories of French and German tours, and which would hold its own with anything to be seen in the Fatherland; next morning another area is visited, where long lines of year-old seedlings under a few scattered trees tell of

* So called in the Working-Plan. What is meant is really "Felling Series."

artificial sowings, the last resort to stave off the slur and stigma of failure. The same compartment will show splendid results in one part, and failure in another part.

Why should such things be? The success we can understand, but how comes it that the chir—that splendid reproducer—with complete protection from fire, grazing and all forms of damage, should fail us in our need? The clue is given in my remarks above. *Without exception*, success has followed in areas with mature umbrella-shaped trees, failure in areas of immature spear-shaped trees. If the area was ripe for regeneration, it responded admirably; if not, no amount of coaxing would induce it to regenerate. So far as the regeneration areas are concerned, that puts the matter in a nutshell.

There is, however, worse to follow. The whole theory of any regular system is to concentrate the regeneration in the first periodic block, and to exclude it from the other blocks. In continental forests the density of the growing stock prevents regeneration from coming up in the older periodic blocks. In our chir pine forests, this is decidedly not the case.

At Ranikhet, for the remaining seven-eighths of the forest not under regeneration, improvement fellings, to utilise dead and dying trees, but not to interfere with the leaf-canopy, were prescribed. These areas were usually open to cattle-grazing (goats are always excluded), but were fire-protected. The net result has been that chir reproduction has sprung up under every group of mature trees, and in gaps, etc. In the felling series where the regeneration areas have proved a failure, we have the comical result of healthy established regeneration anywhere and everywhere except where it should be!

A Forester's soul instinctively gloats over a promising group of healthy established regeneration, but if we are going to make a serious effort to introduce any regular system into our chir forests, we must educate ourselves to a higher plane, and learn to gloat only at regeneration in the right place. This will entail a sacrifice both to ourselves (for who would willingly forego the opportunity of a gloat?) and to the forest, but any method of

transforming our existing hap-hazard forests into a perfect and normal forest is bound to involve sacrifice. If we do not sacrifice it in the seedling stage, we shall, if we hope to get any approach to a regular sequence of age-gradations, have to sacrifice it in twenty or thirty or forty years, at which age it is usually unsaleable, and its clearance will involve time, labour and expense. However, I hope to say more on this point later.

There is one more point to be noted from our experiments in the Uniform Method. The regeneration period was fixed at twenty years, which is certainly not sufficient. Even supposing that regeneration begins at once, after subtracting the time required for the seedlings to establish themselves, we are not left with sufficient time for the young plants to grow up out of danger from fire. It is not sound sylviculture to remove all the seed-bearers before the young crop is safe from fire, nor is it sound forestry to leave large trees after the final fellings have been completed. Taking into consideration that regeneration is not likely to start immediately all over an area, a regeneration period of thirty-five or even forty years is not excessive.

III.—THE VARIOUS SYLVICULTURAL SYSTEMS APPLIED TO CHIR FOREST.

We come now to a consideration of numerous problems. Let us begin by summarising the results we have so far arrived at :

(1) Sowing of chir pine, given protection from fire and grazing, will succeed under the most unfavourable conditions. *Ergo*, we should have no difficulty in achieving success with natural regeneration.

(2) No shelterwood is required for chir reproduction. It is hardy against drought, frost, etc., and its light-demanding nature makes it succeed best in the open. Chir reproduction will, however, establish itself under the moderate shade of a mature and open crop.

(3) Mature trees will give sufficient seed for successful natural regeneration, immature trees will not.

(4) Our existing forests are usually found to be made up of even-aged groups, some will be mature groups, and some immature. Extensive forests of uniformly even-aged trees are the exception.

(5) Given the necessary protection, chir regeneration will spring up under all mature and open groups, it will be absent under immature groups.

Let us see how these characteristics affect or influence our choice of system for the management of our forests. All possible systems come under one of three main heads :—

(1) Clear-cutting systems.
(2) Regeneration in periodic blocks.
(3) Selection systems.

These must be considered separately.

The Clear-cutting systems, of course, give us the normal forest in the shortest time ; and if the sylvicultural requirements of the pine alone were to be considered, such a system would probably be indicated. But in the present state of our forests, any clear-cutting system would involve an enormous sacrifice of immature trees, artificial sowings in the neighbourhood of the immature groups would have to be resorted to, and, so far as I know, clear-cutting systems are never adopted on the continent in steep mountainous country.

Of the Selection Systems, the Pure Selection System (by which I mean taking out single trees here and there), is out of the question, the chir occurs and reproduces naturally in groups, and must be treated in groups. For this reason the Selection-in-Group System has one great advantage, in that we can free groups of regeneration wherever they may be found throughout the forest.

But there are numerous disadvantages. I cannot conceive how, in practice, the selection-in-group system will tend to regularise, or lead up to a normal forest. Also, as already suggested *this is not the best system for* the light-demanding nature and sylvicultural requirements of the pine. And, again, with scattered groups of regeneration, we are increasing the dangers and

possibilities of damage from fire to an unnecessary extent. If the forest is liable to excessive grazing, the same objection applies. Taking everything into consideration, one is obliged to admit that the disadvantages outweigh the one solitary advantage.

To turn now to the systems of regeneration in periodic blocks, which are, broadly speaking, and avoiding minor distinctions—

(*a*) the shelterwood compartment system, and

(*b*) the group system.

Both systems are characterised by concentration of regeneration in the first periodic block, and thereby make a definite attempt to form regular age-gradations, and lead to a normal forest. In both systems, for the same reason, efforts to limit the damage from fire and grazing can with advantage be concentrated on the first periodic block.

As compared with one another, each system is characterised by special advantages and special disadvantages. If we have an extensive area of mature forest, ripe for regeneration, the first system will give us the most magnificent results. Leave five or six of the best seed-bearers per acre, sufficient to give the necessary seed, and at the same time not sufficient to interfere in any way with the reproduction. Spare no trouble or money in keeping out fire and grazing, and success will be assured.

This is an ideal condition, which we seldom find in our forests. Try and apply this system to an area of alternating mature and immature groups, and we shall fail, or at best only partially succeed. Even the finest seed-bearers do not produce sufficient seed to meet the requirements of their own zone, and also the zone of other groups of trees. It is true that chir seed will fly a fairly long distance, but it will not fly a long distance in sufficient quantities to ensure successful natural regeneration. If we put it mathematically, and say that the quantity of seed reaching the ground varies inversely as the cube of the distance from the parent tree (which is probably not overstating the case), it becomes at nce evident.

In such areas the group system with a long regeneration period has the advantage. The overmature groups, and groups

with advance growth can be freed at once. The groups which are not yet quite mature, but which will probably be ready for regeneration before the end of the period, can be left for the present. Groups of quite young poles, say up to 3' girth, if any such groups there are, must be left as part of the future crop. To cut out such groups, with the certainty of having to sow them up artificially, would be an extravagant sacrifice to the ideal of absolute uniformity.

This suggests the great advantage of the group system. Except in conditions most favourable to the uniform system, the greater elasticity of the group system will materially effect the amount of sacrifice involved, albeit, it must be confessed, at the expense of the even-age of the future crop.

But in practice, in working a big block of forest of say 10,000 acres, when probably 2,500 acres will be in the first periodic block, it is most probable that there will be areas more suited to the uniform method, and other areas more suited to the group method. We do not require 1,000 acres of uniform mature forest to start the uniform method, 100 or even 50 acres is sufficient to give us excellent results. In the well-known Forbach "revier" in the Black Forest, I remember that no particular system of regeneration was laid down, the Forest Officer marked in selection, group, or even shelterwood, if he considered it best. This seems to me, with some modification, to contain the germ of the ideal system for our irregular woods.

Let the Working-Plan Officer lay out the various felling series, and select the areas for regeneration; let him fix the annual yield to be cut; let him, if he wishes, prepare detailed maps of the areas for regeneration, and *suggest* where group or uniform fellings are indicated; let him even mark the first two or three years' fellings, to give an indication of how he thinks they should be done, but otherwise give the Divisional Forest Officer a free hand.

This is, to my mind, the ideal solution; the question arises, can we, with our present staff, and with the admitted fact that Imperial Officers are seldom available for marking work, carry it

out? I would humbly suggest that if a more intensive form of management demands more staff, we should ask for it. If we fail to get it, it is our misfortune, but scarcely our fault, and we must do the best we can.

So much for the first periodic block; a word must be said about the remainder of the forest.

I have indicated above that it is not sufficient to get regeneration where we want it; in order to get a regular series of age-gradations we should try and stop it from coming up where we do not want it. Once before I suggested a remedy for this—fire. In precipitous areas, or where soil erosion is paramount, in areas with heavy grass growth where even annual fires are destructive, in areas where, for some reason, a selection system has been adopted, this suggestion could not be carried out. But in other areas, of gentle slope and vigorous growth, with heavy grazing and no grass to speak of, where surrounding villages take a heavy toll of the dry fallen needles, and most especially where (as in parts of the Punjab) complete fire-protection is precarious and unsuccessful, I think the suggestion is worth consideration.

In any large area of forest, the mature areas ready for regeneration will probably be scattered about in various parts. By a judicious division into several felling series, and with a corresponding number of areas to be put under regeneration, it will usually be possible to utilise these mature areas to the best advantage. This would tend to minimise the inevitable sacrifice.

Since writing the above note, I have had the opportunity of studying an interesting report by Mr. M. R. K. Jerram, of the Punjab, on the application of the group method to Himalayan coniferous forests. I am glad to see that many of his arguments and conclusions coincide with what I have tried to show.

He declaims against—

"Impracticability of making gaps of fixed dimensions and a fixed distance apart, and increasing them by a fixed area."

And again

"Neglect of the sylvicultural requirements of the crop, owing to fixed intensity of fellings."

"Stem check is likely to act in opposition to sylvicutural requirements."

"The markings should be done .... on purely sylvicultural principles."

Sylviculture, in short, is his guiding star, and anything which cramps or hinders the applicability of sylvicultural principles is banned. Only I have gone a short step further, and argued for still greater freedom. Mr. Jerram also quotes the Forbach forests:

"The management and sylviculture .... may ... and so far as one can see, do work well," but he thinks that the method would be impossible to apply in India. As carried out in Forbach, I agree, but toned down and modified (almost beyond recognition) as I have suggested, I think it would not be so impossible.

But the main idea which runs through his report is, if I have understood him correctly, a plea for freedom of action. "In the Punjab .... an attempt has been made to make the system almost mechanical," and "Personally I do not think it can ever work satisfactorily." "Give us," he says in effect, "absolute freedom to apply sylvicultural principles," and with this I most cordially agree.

NAINI TAL, U. P.: E. A. SMYTHIES, I. F. S.
20th August 1913.

SOME MINERAL SALTS AS FISH-POISONS.

Some time ago, I received from Mr. E. R. Stevens, Deputy Conservator of Forests, Ramnagar Division, United Provinces, *three samples of soil for examination*, which were said to poison fish. He wrote that, after a few days of heavy rain, a large number of fish were noticed dead in the Mundal river of his Division, and that the local people ascribed the dying of the fish to the poisonous property of the soil washed down by a tributary stream.

The samples of soil were described as follows :—

(1) A very heavy black soil from the hill-side.

(2) A yellow soil collected from the river-bed, derived from the action of water.

(3) Said to be the incrustation of No. 2.

For the purposes of examination, only aqueous extracts of the soils were made. Twenty grams of each sample were boiled with distilled water and extracted up to 500 cc. This preliminary examination gave the following results :—

No. of the soil.	Moisture (by difference). Per cent.	Portion soluble in water. Per cent.	Portion insoluble in water. Per cent.
1 ...	1·60	1·30	97·10
2 ...	15·60	3·90	80·50
3 ...	34·90	62·80	2·30

The composition of these *aqueous* extracts is shown in the following table :—

Soil No.	In 500 cc. of aqueous extract of soil.			Calculated on 100 grams of soil as received.		
	(1)	(2)	(3)	(1)	(2)	(3)
Ferrous Sulphate ...	0·056	0·088	3·38	0·28	0·44	16·91
Aluminium ,, ...	0·036	0·032	0·56	0·18	0·16	2·80
Calcium ,, ...	0·048	0·132	0·52	0·24	0·61	2·60
Magnesium ,, ...	0·020	0·180	0·26	0·10	0·90	1·30
Sodium ,, ...	0·22	1·44	16·04	0·55	3·60	40·10
Sodium Chloride ...	...	...	...	...	...	...

The actual soils Nos. (1) and (2) when acidified gave the well-known silver-staining reaction of sulphide, but no soluble sulphide could be detected in the soil solutions. Twenty grams of each soil were then extracted by 500 cc. of cold water by *shaking*

for four days. The extracts were filtered and tried for soluble sulphide by centinormal iodine solution with negative results.

From the above composition, it is evident that the blackish grey colour of the soil No. (1) was due to the presence of iron in ferrous state and the yellow colour of the soil No. (2) was due to partial oxidation of ferrous into basic ferric salts. The sample No. (2) is more concentrated than No. (1) and bears out its description as being the washings of No. (1) into the bed of the river. The sample No. (3) is evidently, as reported by the local people, an incrustation of No. (2), consisting mostly of ferrous and sodium sulphates.

Of the salts found in the soils, aluminium, calcium, magnesium and sodium sulphates are the usual constituents of natural waters, though sodium sulphate was evidently in excess in this case, and hence suspicion could only fall on the presence of ferrous sulphate and to some extent, on the excess of sodium sulphate and by association on traces of sodium sulphide as the possible causes of the poisonous action on fish. Though I had no opportunity of examining the river water when in flood, it is probable that traces of sodium sulphide or of free hydrogen sulphide gas were also present in it, since sodium sulphide is one of the products of decomposition (though an intermediate one) which is formed during the process of oxidation in soils containing iron sulphide when the latter is converted into ferrous, ferric and sodium sulphates. It seemed likely, also, that as ferrous sulphate would absorb the oxygen gas present in the water on becoming oxidised into the ferric condition, this might be the cause of injury to fish through suffocation.

A preliminary experiment was undertaken with the object of testing the effect of the aqueous extract of the three soils, and also of sodium sulphate and sulphide solution on river fish. As the quantities of the soil extracts available were small, only small fish, each being about 2" long, were used in this experiment.

The results are tabulated below :—

Vessel No.	Contents.	Time of putting in fish.	Condition of fish.
1	The aqueous solution of soil No. 1 diluted with double the volume of pure water.	3 p.m.	At 5-5 p.m., nearly dead.
2	The aqueous solution of No. 2 similarly diluted.	,,	,, 3-23 p.m., dead, rather a weak fish.
3	The aqueous solution of No. 3 similarly diluted	,,	,, 4-4 p.m., dead.
4	3·3% of sodium sulphate solution ...	,,	,, 4-40 p.m., dead.
5	0·5% of sodium sulphate and 0·05 of sodium sulphide solution.	4-30 p.m.	,, 4-32 p.m., dead.
6	2% sodium sulphate and 0·5 of sodium sulphide solution.	...	*Immediate death, blood coming out of gills.*
7	Blank Dehra Dun Canal water ...	3 p.m.	Observed at 6 p.m. in excellent condition, very active.

Further experiments with sodium sulphide and ferrous sulphate were tried with larger fish. The action of 5% of salt solution and sodium sulphate solution was also tested. Fresh fish were obtained for these experiments, each being about 8″ long and weighing about 5—6 ounces.

The results are tabulated below:—

No. of vessel.	Contents.	Time of putting in fish.	Condition of fish.	Remarks.
1	Solution of ·001% of sodium sulphide and 0·2% of sodium sulphate.	2·48 p.m.	5·15 p.m. almost dead.	This is a very dilute solution.
2	Solution of ·05% of sodium sulphide.	3·42 p.m.	Fainted at 4 p.m. Died at 4·9 p.m.	
3	Solution of ·05 of ferrous sulphate.	12 a.m.	Could not remain in the water and began to gape and gasp, holding their mouths out of the water. At 2 p.m., they fainted and were removed to fresh water to revive. They, however, died of the effects.	

(The size of fish in the following cases was about 4″ to 5″ long, and four of them were put in each of the following solutions.)

4	5% of sodium chloride solution.	1·55 p.m.	Died at 2·1 p.m.	
5	5% sodium sulphate solution.	1·32 p.m.	Died at 2·30 p.m.	
6	3% sodium sulphate solution.	1·30 p.m.	At 4 p.m., quite dull, could be touched and caught by hand, but were seen struggling till 6 p.m.	
7	0·05% sodium sulphite solution.	2·36 p.m.	Died at 3·36 p.m.	

From these experiments, it appears that sodium sulphide is poisonous to river fish. A solution containing 0·05% of sodium sulphide kills fish in about half an hour and still more dilute solution even up to ·001% appears to be poisonous although the action is not so rapid. Sodium sulphite also renders the water unsuitable for fish, and in the presence of ferrous sulphate the fish apparently die for want of air. To get air they put their mouths

out of the water contaminated with this salt and ultimately die possibly from mere exhaustion.

With reference to the other salts, it is clear that fresh water fish cannot stand too strong a solution of any salt, but it seems that sodium chloride is more injurious than sodium sulphate. The fish, put in solutions, containing more than 2°/₀ of sodium sulphate after some time become dull and can be easily caught by hand. They cannot bear sodium chloride solution of that strength and immediately become restless and begin to jump out.

It was also noted that if the fish are taken out of these solutions when they show signs of restlessness, they can be revived by putting them in fresh water.

Turning to the special case reported by Mr. Stevens, it is clear that the local country people deserve credit for the accuracy of their opinion as to the soil being the cause of the death of a large number of fish. The deaths appear to be certainly due mainly to suffocation caused by the presence of ferrous sulphate in the river water, and to some extent to the presence of an excess of salts at the time of flood. It is probable also that traces of Hydrogen Sulphide or Sodium Sulphide were present in the river water and that these helped to cause the death of the fish.

In conclusion, I take this opportunity of thanking Mr. Stevens for having brought this very interesting matter to my notice.

PURAN SINGH, F.C.S.,
Chemical Adviser to the Forest Research Institute,
Dehra Dun, U. P.

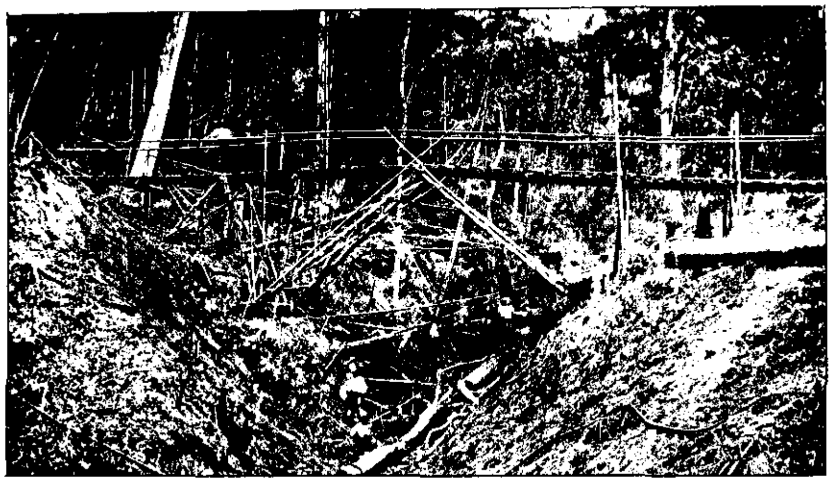

Fig. 1.

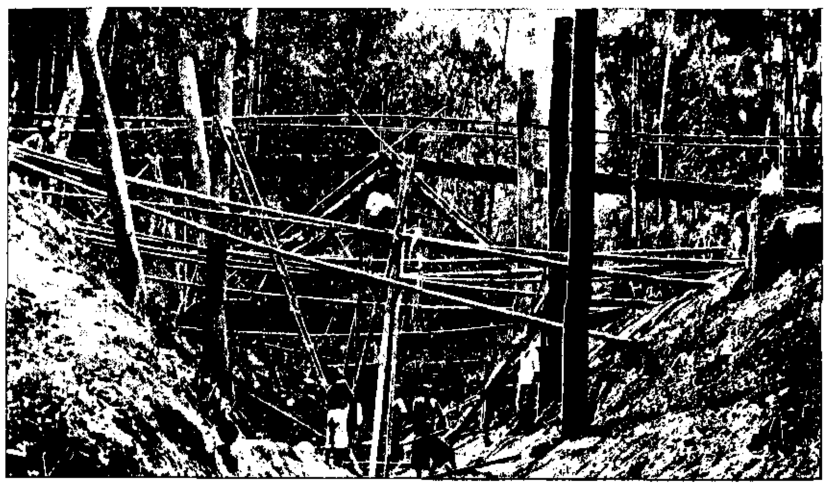

Fig. 2

Fig. 3. Photo. by W. A. Robertson.

Bridges built by the Students of the Burma Forest School.

Photo.-Mechl Dept., Thomason Roorkee. College,

FOREST ENGINEERING AT THE BURMA FOREST SCHOOL.

[*Vide Plate* 14.]

We are glad to see that the importance of giving sound *practical* instruction in the subject of Forest Engineering is thoroughly appreciated at the Pyinmana Forest School—a fact which is well illustrated by the interesting account given below of some bridging-work recently carried out by the students, and for which we are much indebted to Mr. J. D. Clifford, the Director of the School :—

" Fig. 1 is a temporary single-lock timber and bamboo foot bridge with 20-foot frames and the lock 23 feet above the bed of the stream. This was completed within three days of seven working hours, a good deal of the time being spent on other work in connection with the main bridge.

Figs. 2 and 3 show stages in the building of the main bridge. The bridge consists of three spans of eighteen feet, the centre being 24 feet above the stream bed. The posts were of Pyinkado (*Xylia dolabriformis*), 32 feet long, average mid-girth 3 feet, weighing about a ton each, resting on a layer of hard shale 6 feet below the surface for the centre span. The only plant available for getting them into position was a school tug-of-war rope, one old rope and differential pulley and a length of fencing wire borrowed from a saw-mill near by. In addition to the bridges shown in the photographs another was built at the same time at a place some two miles off.

The latter bridge of two spans of 20 feet is not well situated for a photograph but gave more trouble to put up, as the nature of the soil entailed the digging of a cofferdam 12 feet deep in the bed of the stream with a mattress to support the pier.

Work started on the bridges on the 15th February and both the bridges were complete by the 31st March.

With the exception of the felling of two large trees on the bridge site (Fig. 1) by hired labour before the students started work and the digging of the six shallow holes for the abutment posts (Fig. 3) every inch of the work was done by the students themselves. The success of the work was largely due to the supervision and training

given by the Instructor in Engineering, Mr. W. H. Craddock, Extra-Deputy Conservator of Forests. The three photographs were taken by Mr. W. A. Robertson, Deputy Conservator of Forests, and Senior Instructor at the Burma Forest School.

FIRE-PROTECTION IN THE TROPICS.

In the *Indian Forester* for May 1913, Mr. Fischer has renewed his attack on what he describes as " the too much fire-protection " school. A careful perusal of his five conclusions as now modified, however, brings out the fact that none of them justify indiscriminate fire-protection, nor do any of them vitiate " the too much protection " contentions.

For instance, his first conclusion is that " in all forests fires are harmful." No one denies this, but apart from the fact that fires are beneficial in other ways, as he himself admits, the real point at issue is whether the injury caused by the fire is sufficient to justify the cost of protection Mr. Fischer's review merely proves that the evidence based on the ocular estimates of various officers is extremely conflicting. On the other hand, for our moist teak forests, which are the most valuable forests in Burma, statistics have been collected of the number of trees damaged, which prove that the damage does not justify the cost of protection, or if this is too vague, let me state definitely that at the outside the value of the damage amounts only to some Rs. 10 per square mile, whereas the cost of protection averages about Rs. 40.

If instead of tilting at wind-mills, Mr. Fischer is prepared to tackle the real points at issue, I would ask him whether he accepts these statistics and calculations. Assuming, however, that he disputes them, surely he cannot deny that fire-protection should be discontinued until other statistics are collected, proving that the damage does justify the cost of protection.

Because someone else, in order to explain why teak suffers under protection, has stated that fire may be considered as an agent favouring teak at the expense of all (or almost all) other species, I am amused to find that I am accused of *shirking* the enquiry into why we do not find pure or almost pure teak. As

Mr. Fischer admits that in certain forests, fire-protection hinders the natural regeneration of the species we desire to favour, and therefore tends to cause this species to be exterminated, which is the main fact on which we base our contentions, it seems to me immaterial whether or not he understands the theory or explanation which is only given for the purpose of enabling this fact to be realised more clearly.

Since he is so persistent, however, I will explain that the reason why teak does not form pure forests in unprotected areas is because it is inferior to other species in other respects. For instance, teak is inferior to many species in its capacity to endure shade. It does not bear a great quantity of seed. Its seed is not carried great distances by wind, is not attractive to birds, and does not contain a store of nutriment to assist germination, etc.

Mr. Fischer apparently believes that fire-protection should be accepted as a matter of course on the ground that the desirability of fire-protection has not been disputed outside the Indian Empire. This is evidently the idea in his mind when he refers to the proposal to discontinue fire-protection in certain forests as a revolution. The fact that in North America a single fire causes the complete destruction of a forest, whereas in Burma annually recurring fires do not prevent the existence of very fine and valuable forests, proves that the effect of fire differs widely in different parts of the world. The fact, also, that fire-protection hinders the reproduction of some species and is exceedingly beneficial to others, proves similarly that the effect of fire-protection differs as widely as possible. Under these circumstances the question cannot possibly be determined by analogy. Fire-protection is in fact an experiment, and the result can in each case be determined only by careful observation.

Mr. Fischer admits that fire-protection hinders the reproduction of species, such as teak, and his principal, if not only argument, is that this deterioration of the growing stock could be counteracted by improvement fellings and cleanings. We are concerned, however, with practical consideration and not with theoretical quibbles. The possibility of solving the difficulty in

this manner has been raised several years ago, but the Chief Conservator of Forests and the Inspector-General, when tendering their advice to the Local Government in 1907, emphatically stated that such a solution was utterly impracticable. Mr. Fischer himself expressly admits that it is impracticable, and therefore I see no need to take his argument seriously.

Mr. Fischer asserts that we wish "to burn forests." He seems to imply that we have an equal choice between burning and protecting forests, and that any self-respecting Forest Officer ought to choose the latter. I must explain, therefore, that fire-protection is an expensive operation, whereas what he describes as burning forests costs nothing, and is more accurately described as discontinuing the expenditure on fire-protection.

There are two simple reasons for discontinuing fire-protection in forests, such as the moist teak forests of Burma. The first reason is to avoid the deterioration of the growing stock which it has been proved that fire-protection causes.

The second, and to my mind, the more important reason, is to divert the funds and the energies of the staff which are now utilized on fire-protection to tending our forests. Mr. Fischer would not dream of suggesting that a French or German Forest Officer should leave his oak and beech woods untended, and would not call him revolutionary for considering this work essential. Teak is a strong light-demander and has to establish itself under, and to struggle for existence with, species which endure considerably more shade. It is also an exceedingly valuable species, whereas in the majority of cases the species with which it is associated are unmarketable. We have therefore very much stronger reasons for attempting systematically to give teak trees room for development than continental Forest Officers have in the case of oak.

Mr. Fischer, referring to the choice between protecting teak from fire or from suppression, admits that "many saplings are killed by suppression," but adds that others have stated that in Burma "still more are killed by fire." If he places a large branch or section of a teak log in his camp fire, he will find that it is

ignited with the greatest difficulty. He would also obtain useful and reliable information by burning various quantities of brushwood round young saplings. A dry teak tree is more inflammable than a green tree, yet girdled trees are left for several years in unprotected forests, and provided they are not hollow, it is unusual for them to be destroyed. Stumps of trees cut two or three feet from the ground expose as great a surface to ground fires as standing trees, yet very old stumps are frequently found. Bamboos are more inflammable than teak, and are more readily ignited, but in flowered areas the dead stems frequently escape being burnt so long as they remain erect. I have therefore strong reasons for doubting that many solid, vigorous, green saplings are destroyed by fire.

Mr. Fischer also asserts that the "injuries are progressive if fires continue." A scar does not make a tree more inflammable, but merely exposes dead wood, and for the reasons I have given I also doubt whether these injuries are progressive except in rare cases.

As regards suppression no species could exist in these forests unless it produced a great preponderance of seedlings and saplings, and if all survived the ground could not contain the growth. It is evident, therefore, that there must be enormous mortality, not only of teak, but of all species.

I do not think, therefore, that there is any foundation for the assertion that many more teak saplings are destroyed by fire than by suppression. I take a great interest in fire-protection, and I do not think if such a claim had been repeatedly put forward it could have escaped my notice. I am inclined to think, therefore that his prejudice has led him into gross exaggeration.

As regards the effect of fire on the soil, it seems to me that here also Mr. Fischer ignores the facts of real importance, and relies too much on theory. If he wishes to tackle the question impartially, he should, I think, indicate what importance he attaches to this aspect of the question, and state whether he does not agree that the effect of fire-protection on the soil is of very small importance as compared with that on the species. In dealing with

this question I have based my contentions on the fact that the growth in forests which have never been protected is often extremely good, that growth in protected areas is, so far as I can judge, not appreciably increased in vigour, and that when unprotected areas are cleared for exacting field crops no manure is required for several years. Mr. Fischer ignores these facts except to assert that I have forgotten the plough. I am unable to understand his argument. A plough only penetrates some six inches, and if successive annual fires had caused a deficiency of nitrogen, no amount of ploughing would make good the loss. Field crops derive their supplies from the surface soil, whereas the roots of trees penetrate the soil deeply. They are also cultivated for the nutriment they contain, and are therefore very much more exacting. In view of the fact, therefore, that field crops, whether with or without ploughing, can be grown without nitrogenous manure it follows that there must be an ample supply of nitrogen for forest crops.

Mr. Fischer, however, prefers to dispute the theory I have put forward to explain these facts rather than the facts themselves. I admit that nitrogen is an essential plant-food, and that the supply contained in the dead leaves is dissipated into the atmosphere owing to annual fires, but as decomposition is exceedingly rapid, I maintain that in protected areas the bulk of this nitrogen is also lost. On these grounds one would expect a deficiency of nitrogen in both cases, but nevertheless I have good authority for the statement that tropical soils are rich in nitrates. We have, therefore, a loss of nitrogen which does not occur to the same extent in temperate climates, and have to account for a supply which more than counteracts this loss. This I attribute to bacterial activity. Decomposition which is caused by the action of bacteria is very much more rapid in tropical than in temperate climates, and it seems to me a reasonable assumption that these forms of bacteria which extract nitrogen from the atmosphere, should also be much more active. Moreover, in view of the Rothampstead experiments, and the facts proved thereby, it seems to me a reasonable assumption that these bacteria should increase

abnormally owing to the animalculæ which prey on them being temporarily reduced by strong sunlight, and the heat of fires. Mr. Fischer and Mr. Harrison, an expert, brought forward to confound me, have insisted, however, that "the bacterial flora will be greatly reduced" by the heat of fires, and although bacteria have great powers of resistance, I think this is probable; but the point which they appear to have missed is that the animalculæ which prey on them are reduced to a still greater extent, and take longer to recover, and it is this which enables the bacteria to increase abnormally and to accumulate a store of nitrates. Bacteria have extraordinary powers of recovery. They can, I believe, be seen dividing under the microscope, and increase a million-fold in a few days. The expert opinion which has been emphasized by repetition that "some time must elapse before conditions are normal again" strikes me, therefore, as very unconvincing and even humorous.

Mr. Fischer desires me and those who agree with me to trace out his theories to their ultimate conclusion. So far as I understand his argument, several thousand pounds of nitrogen are lost annually per acre owing to fires, and no nitrogen is supposed to be added except 90 lbs. in rain. I calculate on this that in about five or ten years vegetation would languish and that in about twenty years it would entirely be destroyed. I have, however, seen forests in which annual leaf fires have undoubtedly occurred for centuries, and therefore distrust his theories; but I do expect him to believe them, and to trace them to their ultimate conclusion, and his admission that the difficulty of Sal production is owing, not to deficiency of nitrogen, but to physical causes (query the irregularity of the rainfall which the Research Institute has, I believe, discovered to be the true explanation) is distinctly illogical.

Few of us, I think, profess to know much about the chemistry of the soil, and Mr. Fischer has therefore adopted a wise course in calling in the assistance of an expert, and in obtaining his opinion, not on the question of the removal of humus in temperate climates, but on that of the burning of the leaves in tropical climates.

The question of nitrates is, however, a difficult one, and we have therefore a right to display caution. If, however, Mr. Harrison has studied the question, and is competent to advise us, he should be able to give us the results of some definite observations. Field crops are more exacting than trees, but if he can show that the crop obtained from a field in which the stubble was burnt in the preceding year is appreciably inferior to that from a similar field in which the stubble was not burnt, I for one am quite prepared to discard any theory which does not accord with the result.

It is natural that a Forest Officer should dislike forest fires, however mild, and looking back to the early days one can readily understand the anxiety of our predecessors to protect their forests from fire. The first note of warning in Burma was sounded in 1896, and the Local Government, recognising its responsibilities with regard to expenditure, asked the opinion of all Forest Officers whether they considered this expenditure justified, when it was found a large majority were in favour of continuing protection. In 1902 the four Conservators, assuming the desirability of fire-protection was "beyond dispute," proposed to extend protection to all teak forests in Burma within the following five years. Schemes were accordingly prepared for each division, and the first year's work carried out without, so far as I am aware, any protest being raised, but at the same time, I well remember a strong feeling of doubt and uncertainty existed in the rank and file. Shortly afterwards, an officer from the other end of India published some remarks in the *Indian Forester* to the effect that discussion of fire-protection was pernicious. This, curiously enough, started a lively controversy in which many of the claims for fire-protection were severely criticised or disproved. Consequently the scheme to extend protection was quietly dropped, but the area already under protection was not appreciably reduced. The reason given for taking no action was that Burma Officers were suffering from a reaction, and presumably, therefore, were incapable of exercising a sound judgment in this question.

Mr. Fischer may, I think, fairly claim, in respect of his review of all that has been written on the subject, that the balance of

opinion is adverse to our views, but this is therefore explained by the fact that the desirability of indiscriminate fire-protection was not disputed until 1896, and that even as late as 1902 we acquiesced in extending fire-protection indiscriminately to the remaining teak forests.

He is also able to quote against us the opinions of many men for whom we rightly have a great respect, but their opinions on this particular question were based to a great extent on speculations as to the probable effect of fire, and many of the claims put forward had never been challenged, whereas our opinions are based on observations of the actual results of fire-protection, and on facts which, when disputed, we have had ample opportunity to verify.

We have been given to understand that we are incapable of exercising a sound judgment on this question. The scheme to extend fire-protection was, however, engineered entirely by an Indian Officer with little experience of Burma, and therefore it is not clear why we should be suffering from a reaction. In any case nearly ten years have elapsed, and we have had plenty of time to recover our balance.

Mr. Fischer states that he "wants more accord among Burma officers." He presupposes a discord, however, which exists only in his own imagination. In order to determine definitely the present state of opinion I recently wrote round unofficially to my fellow Divisional Officers to ascertain their views. The majority replied, and all except two junior officers who hesitated to express a definite opinion, but were not opposed to us, declared themselves in favour of a considerable reduction of the area under protection. It must not be concluded, however, that we desire to abolish fire-protection altogether. In applying fire-protection the only point considered has been the value of the forests, but we now recognise the principle that we must discriminate according to the effects of fire-protection in different forests. We are unanimous in thinking that the present programme of fire-protection needs drastic revision, but although we maintain that fire-protection should be discontinued in certain forests, we do not deny that it could be

extended with advantage to other forests in which protection has not yet been started, nor that it has been of great benefit in many parts of Burma and India.

I have no doubt that Mr. Fischer earnestly and sincerely believes that under no conceivable circumstances could fire-protection be carried too far, and his scorn for the mistakes I have made indicates that when once he has made up his mind nothing would induce him to modify or to revise his opinion. Nevertheless, even Mr. Fischer must, I think, admit that those on the spot have greater facilities for ascertaining the facts, and as the question depends on observation must be the best judges.

August 1913. H. C. WALKER, I.F.S.

EXTRACTS.

MATCH FACTORIES IN BURMA.

Burma, on account of its plentiful supplies of suitable timber, is supposed to be just the place for a match factory. To be sure, we have two already—one in Rangoon and the other one in Mandalay—but the idea has been abroad for some time to go one better. The talking stage has now been passed and I see that the prospectus has been issued in London of the Indo-Burma Match Factories, Ld. The capital is to be £30,000 divided into 29,900 participating preference shares of £1 each and 2,000 ordinary shares at one shilling each. These shares are to receive a cumulative preferential dividend of 10 per cent. and, in addition, 50 per cent. of the remaining profits. This seems to be liberal enough. The only question is whether a match factory can earn such profits. Perhaps it can, even though matches can be bought here retail at a dozen boxes for an anna and a quarter. However, the Board of Directors is a fairly strong one and comprises Mr. T. H. S. Biddulph, C.I.E., Major-General Sir Stuart Beatson, Sir C. H. Bedford, Mr. W. A. Murray and Mr. G. C. Evance, who is to be managing director in India and Burma. In India you have several native-owned and managed match factories, but these are said to be fitted with out-of-date machinery, and, so far as I can make out, it will be part of the duty of the new company to wipe these out, on the principle, I suppose, that the fittest survive! The new venture is to have automatic match-making machinery, by which is meant that you put pieces of wood in at one end and obtain boxes of matches at the other, or words to that effect, as the lawyers say.

*   *   *   *   *

At any rate Mr. Evance is convinced that matches can be made in India at a price below the cost of manufacture in Europe, though equal in quality to any matches imported. Moreover, the Government of Burma have been interested, and have agreed, I

understand, to grant a wood concession to the company, besides offering the services of forest officers in selecting this concession. The first factory will be erected near Rangoon at a cost of £7,200 for machinery and buildings. It all looks very rosy on paper; and the brightness of this match picture is not dimmed by the assurance of the directors that the figures of the estimated profits show a balance sufficient to provide a further forty per cent. dividend on the participating preference shares. Yum, Yum! *Just fancy what a scramble there should be for an investment that* will probably earn a fifty per cent. dividend. But it may possibly be difficult to prove to some hard-hearted unbelievers that there is so much money to be made out of matches. But *nous verrons.*—[*Capital.*]

MANGROVE BARKS FOR TANNING.

[*The following Note has been prepared by Mr. R. S. Pearson, I.F.S., F.L.S., Economist to the Forest Research Institute at Dehra Dun, for the purpose of indicating to persons interested in the tan extract business the localities where Mangrove Forests predominate and from which it is possible to exploit the bark.*]

Owing to the ever increasing shortage of tan barks and tan fruits in Europe, either obtained at home or from abroad, the question of finding new sources of supply has from time to time been considered, but probably never to the same degree as at the present day when the Chestnut bark from the Continent has not only gone up in price but become more and more difficult to obtain. The result of this position of affairs has been that enquiries have become more frequent for Indian tanning agents such as

Babul, Tarwar and Mangrove barks and for tan fruits such as Myrabolans, Babul pods, Divi-Divi, etc. In order to obtain more reliable data as to the commercial value of some of these and other tanning agents, the supply available, and cost of extraction, the Forest Department have been engaged for the past three or four years in collecting information on these points.

The most promising tan bark, as far as can be seen at present from which to prepare tan extracts for export to Europe, is that obtained from Mangroves. Experiments were carried out by the Forest Chemist in the Tan Extract Factory at Rangoon, working on a commercial scale with Mangrove bark, the results of which were published in the *Indian Forest Records*, Volume III, Part IV, " Note on the preparation of Tannin Extracts," in which he clearly demonstrated that extracts of good quality could be prepared from this bark which were saleable in Europe.

However, demonstrating the value of the extract for tanning purposes is not sufficient to induce a firm to consider such a business ; they also require figures of outturn, cost of extraction and details regarding locality and on these points some information is now available.

The largest Mangrove forests are found down the coast of Arakan, extending along the Bassein coast towards Rangoon, and again along the coast of Mergui and Tavoy in south Tenasserim. Considerable areas of this class of forest are also found in the Sunderbans and in the Andamans.

In Arakan the two commonest species found are *Rhizophora mucronata* and *Rhizophora conjugata*, forests of which are estimated to cover 2,000 square miles, chiefly in the Sandoway and Kyaukpyu districts. The Divisional Forest Officer says that he cannot vouch for the accuracy of this figure, though it is stated by him that the area is very great. It is thought that in the event of a firm applying for a lease it would be possible to mark out a reserve from which the bark could be taken, working on a fixed rotation and royalty charged on the outturn of the finished product. By such an arrangement the lessees would be secure from any interference with their work by private traders. An experiment

has been recently carried out in the forests referred to above by Mr. Hamilton, the Sub-Divisional Forest Officer, in which one acre of forest was felled and the bark stripped from the trees to ascertain the yield per acre, and it was found that it amounted to 6,760 lbs. or just 3 tons of bark and 2,500 c. ft. of fuel stacked. Working on a 40-year rotation and taking the yield at 3 tons per acre, it would therefore require about 400 square miles of forest to keep a factory working which dealt with 20,000 tons of bark annually, an amount that there would be no difficulty in obtaining, as the area of Mangrove forest far exceeds 400 square miles. The actual cost of felling and stripping the bark came to Rs. 15 per acre or Rs. 5 per ton, while the cost of conveyance to a suitable factory site would not be more than Rs. 2 per ton, for the reason that the forests are on the coast and carriage by boat possible. It is thought that both felling, stripping and transport of the bark could be arranged for by contract, while the wood and leached bark provide an excellent fuel. The most suitable sites for a factory would be either Sandoway or Kyaukpyu, as the waterways and creeks which cross the Mangrove forests leading to these places afford excellent lines of export for the raw material throughout the year. Labour is plentiful at 8 annas per day, while coasting steamers of the British India Steam Navigation Company call frequently at both ports.

Another locality in which Mangrove forests exist is down the coast in the Bassein district. They are found in this locality from the Laumgyi River to the mouth of the Kyonkadum and also in the Mwedon and Pokweyo forests. The cost of felling, stripping and carrying to Pyapon or Bogale, where the Irrawaddy Flotilla Company boats call from Rangoon, is estimated by the Divisional Forest Officer at Rs. 20 per 1,000 Viss or Rs. 12-8 per ton. The total amount available is not stated, though about 5,000 trees are felled annually in Mwedon and Pokweyo forests which yield about 18 to 20 lbs. of bark per tree. Other Mangrove forests also occur in the Kyagon, Nyaputaw, Einme, Sinma and Bassein Ranges of this division, but are not worked at present for firewood or the bark.

Very extensive and workable forests of Mangrove occur in South Tenasserim in the Tavoy and Mergui districts. The Divisional Forest Officer writing in this connection states that the supply of bark is more or less unlimited, the majority being available from the Mergui district and a certain amount from Tavoy. The cost of "extraction"—in the forest sense of the word—is put at Re. 1 per 100 Viss or Rs. 6-4 per ton, this figure being based on experience gained in sending bark to the Experimental Government Tan Extract Factory in Rangoon. The cost of extraction stated above also agrees fairly well with the figure arrived at by Mr. Hamilton in Arakan. Were the bark shipped to Rangoon it is estimated that it would cost Rs. 16-5 per ton ex-ship. Together with Arakan there is little doubt that Mergui and Tavoy districts present the best localities in which such an industry could be carried on.

Large quantities of Mangrove bark are exported from the Sunderbans to Calcutta, but owing to the bark already finding a market in this locality and due to the proximity of the forests to Calcutta prices rule high, while in the Andamans, though there exist very extensive forests of this class, the want of labour at once prohibits the establishment of such an industry.—[*The Indian Trade Journal.*]

ADULTERATION OF TURPENTINE.

AMERICAN STANDARD GRADE.

The abstract of the proceedings of the Bengal Chamber of Commerce for June 1913 contains a reference to the question of the importation of reduced turpentines. The Government of Madras had recently desired to prevent the importation of adulterated or reduced turpentines on the ground that ignorant buyers were deceived. The Government of India consulted the Local Governments and through them the local commercial associations. But there is one aspect of the adulteration question which has not come under the consideration of the Chambers and that is the difficulty of obtaining in the Indian markets any such price quotations for pure turpentine as shall be comparable with those reported

from Western markets. The standard grade of turpentine for such quotations in London—and London is the chief market for turpentine—is "Genuine American." It is produced from the *Pinus longifolia* found in North and South Carolina and also from the *Pinus tæda* commonly known as the Lob-Lobby pine. It is usually considered the best quality Turpentine in the Varnish and Paint Trades, but chiefly, however, on account of its smell. Turpentines produced from France and Spain come from the *Pinus maritima*, and are almost precisely the same in smell. They differ, however, slightly from the American, and it is chiefly on account of this that they command a lower figure in price. Whilst they can be classified as "Genuine Turpentines," they cannot be considered as quite equal to the American quality in value, as the reputation of this latter appears to command a higher figure. Russian turpentine is of a very different quality, being produced from the *Pinus sylvestris*, and by an entirely different process. It contains a very much larger amount of Resin, and therefore oxydises considerably slower. On account of this, and also because of the very strong odour, this Turpentine fetches a very much lower figure than either the American or the French, and may be classified as a decidedly lower grade. German, Swedish, and Finnish Turpentines may also be put in the same category with Russian. The above-mentioned turpentines are seldom if ever used in the manufacture of Varnishes, and rarely in the case of Paints.

The generally accepted final authority in the United States for correct grading is the New York Naval Stores Committee; and the following Specification for Genuine American Turpentine, as used by the United States Navy Stores Department, is published for information :—

1. The spirit must be clear and water white, and be the properly prepared Distillate of the oleo-resinous exudation of the proper kinds of pine unmixed with any other substance.

2. A single drop allowed to fall on white paper must completely evaporate at 70°F. without leaving a stain.

3. *Sp. Gr.*—At 60°F. from ·862 to ·872.

4. *Distillation.*—The initial Boiling Point must not be lower than 3050°F. and 95°/ₒ volume, must distil below 332°F.

5. The residue from evaporation in an open dish over the water bath must not exceed 1·5°/ₒ by weight of the spirits.

6. *Refractive Index.*—1·468 to 1·476 at 68°F.

7. *Flash Point.*—Must not be below 92°F. (closed test).

8. *Sulphuric Acid Test.*—Into a 30 cc. cylinder put 6 cc. of the turpentine, immerse the cylinder in water at 50°F. and slowly fill to near the top with Sulphuric Acid of 1·84 specific gravity—mix thoroughly cooling at short intervals. Allow to remain at rest for one hour and read off the volume of residue. It should not exceed 6°/ₒ of the volume of spirits used and should have a refractive index of at least 1·500 at 68°F.—[*Indian Trade Journal.*]

TIMBER *VS.* STEEL SLEEPERS.

As an outside opinion we quote the following remark of the Prime Minister of the Union of South Africa :—" It is correct that the steel sleepers in the railway line between Standerton and Volksrust are being replaced with Australian jarrah wood sleepers, where such can be procured at a reasonable cost. The reason why steel sleepers are being discarded is that the latest type of *steel sleeper, with pressed out lugs, has proved too weak whenever* it has been used for the present heavy axles in use and high speeds attained, while, in addition, it has proved to be an unsuitable type where stone ballast is used." These sleepers, we presume, are the same as those we call steel trough sleepers in India and which are much appreciated on the Bengal-Nagpur Railway. If so it is difficult to account for the difference of opinion regarding them. Besides jarrah the South African railways also use karri sleepers largely ; but these are first preserved by the Powell process. The preservation is carried out by the West Australian Government who have set up plant with the intention of treating all the sleepers to be used on their portion of the trans-continental line to be built between Kalgoorlie and Adelaide.—[*Indian Engineering.*]

FORESTS AS A PROTECTION OF HILL SLOPES.

A controversy has recently sprung up as to the real effectiveness of forests in preventing landslips, and the reply has been given emphatically in favour of forests by a writer in the Bulletin of the Bureau of Agricultural Intelligence and Plant Disease, Rome. Because the roots of a forest growth find their way into the crevices of rocks and to some extent tend to separate rock masses it has sometimes been assumed that they loosen the masses and bring them down. But the fact of there being a fissure is itself the cause of weakness, and though it is filled by *débris* the *debris* does not cement the masses together. On the other hand roots by finding their way in among the masses and enveloping them tie them together as a cord would do. Moreover, were there no covering forest varying temperature, the action of water and of frost would be much more severe at these fissures and soon increase them. Although it would be an exaggeration to say that forests are the only remedy against landslips, there is no doubt that in the first place they never promote slips while deforestation frequently does, and that they materially assist in preserving slopes, and are often in themselves a preventive against landslips.—[*Indian Engineering.*]

DESTRUCTION OF *LANTANA.*

This plant is apt to become a great nuisance in tropical countries on cultivated and pasture land, owing to its dense growth and extraordinary vitality. It appears from the *Journal d'Agriculture Tropicale* (1912, 12, 154) that an attempt is now being made in New Caledonia to combat the pest by introducing a species of fly of the *Agromyzidæ* family from Hawaii. The insects have been distributed in the environs of Noumea on land infested with lantana. As a result, the larvæ of the fly have been found in many of the seeds, and it is intended to extend its distribution in the colony. The result of the experiment will be watched with interest ; it must be borne in mind, however, that where a new

animal species has been introduced to destroy some pest it has itself sometimes proved to be injurious in other directions.—IMP. INST. BULLETIN.—[*Tropical Agriculturist.*]

BAMBOO SUPPLIES IN INDIA.

GOVERNMENT CONCESSIONS TO INDUCE ESTABLISHMENT OF PAPER MILLS.

There is an immense possibility, remarks the *Beharee,* for the paper manufacturing industry in the State of Cochin, as bamboos grow in abundance. The Durbar are prepared to grant free of assessment for a period of 12 years a tract of land necessary for the erection of the factory buildings. Other concessions offered are a supply of bamboo required for the manufacture of pulp for a period of five years at the actual felling and transport charges, and a supply of fuel at actual collection charges for the first five years and at a profit of eight annas a ton during the remaining seven years. During the first five years the pulp manufactured from bamboo will be altogether exempt from royalty while thereafter a royalty of one rupee per ton will be charged. It is also stated that the Durbar will consider any other alternative proposals for easing out bamboo-producing lands for a long period for the purpose of extracting bamboo required for the manufacture of paper and for growing bamboos in selected areas.—[*Paper Trade Review.*]

A SUBSTITUTE FOR HORN.

A combination of leather and celluloid is treated in the following way for the production of a horn substitute. The hide is depilated and then extracted with amyl acetate and acetone to remove fleshy matter and to produce a hardening effect. Subsequently it is coated with a solution of celluloid in amyl acetate and acetone. When the solvent has evaporated, the hide is placed in a bath of shellac dissolved in alcohol. It is said that the hide thus treated is not only similar to horn, but possesses its elasticity and strength; the product is strong and light, and is suitable for the manufacture of trunks, boats, and insulating materials.—*Journ. Ind. and Eng. Chem.*, July 1913, 608.—[*Pharmaceutical Journal.*]

PRESERVING CUT FLOWERS.

The principles of osmotic pressure have recently been applied to the art of preserving cut flowers, and the results have reached a point "undreamed of a few years ago." Sugar solutions of varying strengths have proved the most effective, except in the case of lilies, lilacs, and sweet peas. Carnations lasted longer in a 15 per cent. sugar solution, while roses were most permanent in a solution of half that strength. Chrysanthemums and tulips are not benefited. Although lilacs are not benefited by a sugar solution only, yet if they are kept in a 12 per cent. sugar solution which also contains one-hundredth of 1 per cent. of manganese sulphate, they last much longer than usual, and improve in tint. It has been found that when the osmotic pressure of the solution outside equals that of the juices in the flower, the best results are obtained.—*Sci. Amer.*, through *Mid. Drugg. and Pharm. Rev.*, July 1913, 331.—[*Pharmaceutical Journal.*]

SAWDUST AND THE ADVANCE OF SCIENCE.

Sawdust, the lowly neglected residue that has long played a Cinderella part in the pantomime of the wood trade, is looking up; gentlemen of this century with scientific leanings are taking it by the hand and introducing it into circles where it has hitherto been neglected and despised. There was a time, and that not far distant, when its highest office was to fill a tavern spittoon, stuff a doll, or a pillow for the head of the departed. What a change! What a bolt from the blue! And we are now told it can be converted into "rubber," one of the most valuable and widely sought commodities within the reach of man, and that its day as a waste material is now past.

This introduces us to the "Synthetic Products Co., Ltd.," with works of an experimental character at Island Wharf, Rainham, Essex, whose products are acetone, fusel oil and synthetic rubber. The origin of the concern is due to a group of eminent scientists—chemists, bacteriologists and engineers—brought together by Strange and Graham, of City Road, London, E.C., for

the purpose of attacking a number of industrial problems, several of which have already been solved very successfully. But this latest venture eclipses all that has hitherto been attempted. It is nothing less than the accomplishment by artificial means of that which it has hitherto been supposed could only be performed in Nature's own laboratory. The rubber which has been produced in the laboratory has been reported upon by scientific experts, who declare that under all chemical and other tests it acts exactly the same as natural rubber, that it can be vulcanised, and there is every reason to believe that it can be produced on commercial lines of at least as good quality as, and at less cost than, the natural article.

Synthetic rubber, acetone and fusel oil have already been produced on a fairly large scale at Rainham, and proved to be a success, commercially and otherwise; and, apart from their usefulness in the rubber-producing process, there is a great demand for them in various industries. Both are largely used in the manufacture of cordite and other explosives, and fusel oil is also required in the making of artificial leather cloth. Hitherto fusel oil has only been obtainable as a by-product in the manufacture of whisky, brandy and vodka, and its output has therefore been strictly limited by the market available for ordinary alcohol. It has now been proved, however, that it can be obtained cheaply from maize or any other cereal, from potatoes, from sugar beet, and even from sawdust—in fact, sawdust is the raw material which will probably be chiefly used, on account of its cheapness; but in the first instance potatoes will be employed, owing to their smaller bulk and consequent greater output per plant unit. The process by which the acetone and fusel oil are obtained from the raw material is an extremely simple one, being carried out mainly by fermentation. From acetone and fusel oil is produced isoprene, which can be changed into rubber merely by allowing it to lie in contact with a small quantity of the metal sodium.

We learn from the *Lynn Advertiser* of June 20th that the King's Lynn Dock Co. have let the disused oil-mill and four and a half acres of land adjoining on the Alexandra Dock to the above

company as an enlargement for further developmen' of the parent works at Rainham, in Essex. Alteration of buildings and installation of plant is to proceed at once, and it is estimated that the manufacture of products will commence there in three or four months. They will be capable in the first instance of producing 500 tons of acetone and fusel oil per annum, with the prospect of an almost immediate increase to 1,500 tons per annum. It is looked upon as a very profitable business, for by means of simple processes raw material costing £1 to £2 per ton will be converted into products worth £80 per ton. To produce 500 tons of these products some 5,000 tons of sawdust would be required ; but if potatoes were used the weight of the raw material would be much less. In addition to the four and a half acres on the Alexandra Dock which the company have hired—on a lease which may, at their option, be extended to fifty years—they have also obtained an option over a further thirteen acres on the Bentinck Dock.

The selection of King's Lynn for this expansion of a new trade is not on account of a mountain of sawdust such as is, or was, recently seen as bugbears of saw-mills in the North of Europe, for such a store does not there exist. The selection of that site or port has been in consequence of its proximity to the Fen or potato-growing district. Sawdust will have to wait its turn, which will no doubt mean the business travelling further North.

It appears from the above that the man who uses the modern phrase "The day of miracles is past" is on the wrong side of the hedge !—[*Timber Trades Journal.*]

PRESERVATION OF WOOD.

Epinoy utilises the property of the alkaline bichromates to render gums and gelatines insoluble when exposed to the light. For this purpose the wood is immersed until complete saturation in a solution containing 2 per cent. bichromate of potash and 1 per cent. fluoruse of sodium. After drying, the wood is proof against rotting. The wood is then painted with a solution containing 2 per cent. bichromate of potash, 0·4 per cent. fluoruse of

sodium and 5 per cent. of gelatine, and is exposed to the light; after drying the wood will be covered with a very strong brilliant varnish, and assume a brown colour, like aged wood.—[*Scientific American.*]

RUBBER ROADWAYS.

Among the uses for rubber mentioned by Mr. A. Staines Manders are rubber roadways, flooring and tiles. In his opinion, "before long the flooring of every new public and commercial building will be covered with rubber in some form or other; the article deadens the sound, it is more sanitary and wears longer than any other material, and it pays over and over again the initial cost. The warships of to-day and large mercantile steamers use a very large amount of this commodity, and the time is not far distant when every steamer built will have rubber in place of other articles it uses to-day as a substitute...... As to the crude products in which so many millions sterling have been invested, the bogey of over-production is not possible, at any rate for many years to come; the general public have no idea that if the vast production of crude rubber failed the commercial world would soon be brought practically to a standstill; without rubber the electricity, whether for power or lighting, would cease, telegraph and telephones, electric trains, trams, etc., would be useless, to say nothing of motor traction, etc. The rubber industry of to-day is small compared with what it will be in two years' time." Tyres on vehicles of every kind may swallow up a large proportion of the huge supplies of rubber which will soon be coming forward, but other uses will also have to be discovered. The suggestion regarding rubber roadways is by no means new. There was such a roadway fifteen years ago under the central arch of the London and North-Western Railway Hotel at Euston, and it would be interesting to learn how that means of deadening sound answered expectations.—[*British Trade Journal.*]

THE MATCH-MAKING INDUSTRY IN JAPAN.

The Government of India's prohibition of white and yellow phosphorus matches has attracted notice here but has not created any stir. It is said to have caused a temporary set-back to the trade, but the present slackness is probably more the effect of ordinary trade fluctuations than of anything else, and there is not so much difference between the various kinds of matches but that the prohibited sort can be immediately replaced with safety matches. Last year the export of matches to India was 1,783,872 yen in value, and that to China (including Hongkong) 8,749,428 yen, and as the prospects of starting the match industry have been much discussed in India during the past four or five years, some account of how the industry is conducted in Japan may be of interest to readers of the *Indian Textile Journal.*

Kobe is the chief centre of match manufacture, there being some three dozen factories, employing about nine thousand hands. Many of these are small concerns, and even the large companies do not concentrate their energies under one roof, but have half a dozen factories scattered about the city. Exactly why Kobe became the centre of the industry it is not easy to say. It was, no doubt, partly because one of the early men of the new era started a factory in 1877. Of late years the fact of being handy for the Indian and China trade has had most to do with the great increase in the local manufacture. Except as a place of export the city possesses no advantages, since all the materials come from a considerable distance. The phosphorus and other chemicals come from England, Germany and America; the wood comes from the Hokkaido (the northern island) and sulphur from Oshu district. The soft white wood used for both matches and boxes grows most plentifully in the Hokkaido, and some of the larger factories have their own branches there, for the supply of these chief requirements. There are also independent factories, and the preparation of sticks and the veneer-like strips for the boxes is even a sort of large-sized cottage industry. The cutting machinery is simple, and men go in for a small oil engine and buy the odds and ends from saw-mills and timber merchants, often being able to undercut factory

rates by this means. The sticks, when cut, are tied in bundles, and baled up in straw, somewhat loosely, a small percentage working their way through. The box wood is more of a regular factory article, the wafers of wood being cut in three sizes for each type of box and properly scored for folding. These, like the sticks, are shipped in bulk as they come from the machine to Kobe.

The box-making is a cottage industry. Small cultivators get supplies of wood, paper and glue from the factories and take them home, where the women and old people, and, much more than ought to be the case, the little children, make them up. They become very deft, fording the stripes, glueing the paper and applying it to the wood with a mechanical precision. One of the common sights in the streets in Kobe is the hand-cart on which most of Japan's traffic is carried piled up to a great height with stacks of empty match-boxes on their way to the factory. At the factory there is very little power employed, and not a great deal of machinery. The Harima factory may be described as an average-sized and typical one. It is a roomy and well-lighted place, consisting of ground floor only, in which the matches in course of making, travel round three sides of a square, and are finally brought out to the packing shed which stands in the middle of the yard. The sticks, on being taken from the bales, are tossed on to a machine something like a compositor's "upper case," but oblong boxes. This vibrates strongly, and shakes the sticks down on to a partitioned tray, all orderly and parallel. These are used to replenish other vibrating machines, of which there are two rows, down a long room, numbering about thirty in all. Collapsible grids are placed in these machines, and are fed through a plate drilled with rows of holes from a solid mass of sticks standing on end, which have been brought from the first vibrating machine. Two or three turns, making this machine also vibrate vigorously, are enough to fill each grid, which grips the sticks pretty tightly. The grid is put in a press which gives the sticks a levelling bang, and a pretty hard one considering their individual frailness. Attached to the press is a bath of hot paraffin wax, in which the ends are dipped by a mechanical contrivance. The dip into

the chlorate of potash mixture is done by hand. Match is now complete, and after being dried in a hot room, the grids are opened over another vibrating machine, which shakes them down into long parallel rows in trays. These trays go into the biggest room in the factory, where the women and girls pack the boxes. There is a constant procession of match-trays and piles of empty boxes, and the women and girls squat down before low tables to fill. Great dexterity is shown in this operation, and by none more than by the numerous small girls of apparently not more than six or eight. The box is taken by the left hand, one finger pushing it partly out, the outer cover is seized between the lips and drawn off. The right hand takes just the right quantity of matches from one of the rows in the tray, a couple of quick motions fill the box exactly full and press the matches down, and, returning towards the mouth, the filled box re-enters its cover and is thrown aside. Less like a conjuring trick but with the same mechanical efficiency, is the pasting of the labels on the boxes—a horrible figure of Kali for Calcutta, and red lion (suspiciously like the British heraldic carnovore) for China, and a device bearing the name of Essabhoy for Bombay. The pile of labels, turned over, is stroked along the board like a pack of cards. A broad brush glues the topmost label and picks it up at the same time. The match box is held in the left hand, and one movement of the thumb draws the label off the brush and on to the box. The boxes are assembled on a stand and covered with a perforated frame for painting on the phosphorus mixture. A second drying-room makes the process complete. There is still the packing in dozens and grosses, then into soldered tins by the thousand and into packing-cases by the ten thousand.

Study of the requirements of the markets is shown not only by the labels but by the various sizes of boxes. China takes the biggest box, Bombay the smallest. Employees of all ages number about 350, and the outturn is from 35 to 40 cases (containing from 50 to 75 gross each) a day. For smokers' use in local consumption, a neat little packet is made, something like the Indian postage-stamp books in appearance. It contains a couple of dozen

matches, sometimes held in a thin paper inner cover, sometimes consisting of special wood, which is not split to the very end, the joined ends being glued to the wrapper. A dab of the phosphorus mixture across the inside of the wrapper provides "the means of ignition."

It will be seen, then, that only five machines are generally used in Japan in match-making. Two of these are used for cutting the sticks and the shavings for the boxes. Both are power machines, but are not complicated, the chief thing needful being the keeping sharp of the cutting edges—a virtue which apparently comes by nature to the Japanese workman, and which seems to be the most distinctive difference between his methods and those of the Indian. It is not so much a difference in human nature, however, as in wood. The hard woods in common use in India are amenable to treatment with tools whose bluntness would ruin work in the softer white woods used in Japan. However, if the Indian takes up this sort of work, the sharpening habit is one that he must get into. The other three machines are simply vibrators for shaking the matches into line, and are turned by hand. The press, which gives them a levelling bang before dipping, and the frame which dips them in the hot paraffin wax are hardly machines, in that there is nothing in them to get out of order. The three vibrating machines could never go wrong or even wear out except by gross and inexcusable mishandling. As for the personnel of the Japanese match factories, there are, on the machines which shake the matches into the grids for dipping, far too many boys who ought to be in school, and there are in the filling room far too many girls who ought to be in the nursery or the kindergarten. Of these last, however, though one does not like to see such a grown-up and uncanny deftness in small children, or such a constant and monotonous occupation, those whom I saw did not appear either unhappy or unhealthy. But the conditions, nevertheless, would not be allowed anywhere that an effective factory act was in force, nor is the cottage box-making industry one which has any other excuse for existence but its economic value. —[*Indian Textile Journal.*]

DEPARTMENTAL FIRING IN CHIR *(PINUS LONGIFOLIA)* FORESTS IN THE RAWALPINDI DIVISION, PUNJAB.

Chir forests in the Punjab are far more exposed to the risk of forest fires than any other coniferous woods. They are situated on the lower slopes of the Himalayas where the summer heat is sufficient to dry the soil covering of dead needles and grass to such an extent that from April till the end of June fires are started very easily and spread most rapidly. The Rawalpindi Division has a particularly bad reputation for fires, and though regular fire-protection has been attempted since 1896-97 little success has been achieved. The forests have generally escaped for three or four years and in the next year have been burnt out. In the years before 1896-97 fires were even more prevalent and in the early history of the division apparently raged unrestrained. Most of the fires are due to incendiarism, sometimes in order to get better grass, sometimes to pay off old grudges and get the right-holders into trouble. The experience of the years 1911 and

1912 would seem to prove that the Forest Department is quite helpless to cope with a serious outbreak of incendiarism. Fire-lines, fire guards, special night patrols, etc., have been tried in vain and there is unfortunately no doubt that once the villagers have made up their minds to burn the forests the Forest Department is powerless to prevent them.

Notwithstanding the fact that the forests have been burnt over they are in far better condition than anyone, unacquainted with the marvellous power of recovery possessed by chir, would imagine. This power of resistance to fire it owes to its thick bark and to the fact that most of the fires are *ground fires*. The flames from these ground fires often scorch and kill the branches up to fifty feet from the ground and occasionally cause isolated and disastrous crown fires. The regeneration below a height of five to eight feet is almost invariably destroyed over the greater part of the forest, saplings are often burnt, while pole crops and mature woods generally escape with their bark and lower branches severely scorched. The damage done varies with the intensity of the fire and in slow fires is but small. This fact, combined with the practical impossibility of successful fire-protection over long periods, suggested to some forest officers, including the late Inspector-General, that it might be possible to work out a scheme for firing departmentally a chir forest during part at least of its life. This question was first raised thirty years ago in the interests of the villagers, as grass and grazing grounds quickly deteriorate if not fired at fairly short intervals. The question is now being raised *in the interest of the chir* on the grounds that it is impossible to protect a chir forest from fire for more than a few years.

Fire-protection helps the accumulation of fallen needles, dead wood, and old grass till, at the end of a few years, a fire-protected forest is in a far more inflammable condition than it would have been if slow ground fires had passed through it at regular intervals. In such a forest a fire is abnormally fierce and its harmful effects are accentuated, trees being killed which would have been merely scorched by a more gentle fire. A

fierce fire is not so likely to run through a forest once the mass of combustible rubbish has been got rid of.

The first detailed enumerations and measurements were made in December 1912 to ascertain the percentage of surviving trees in the areas which had been burnt in the preceding hot weather. The result of several thousand measurements showed that a chir tree is ordinarily safe from being killed by fire once it has reached a girth of eighteen inches at breast height. The percentage of trees killed ranging between eighteen inches and two feet in girth was ten per cent. only. These and other observations, however, showed that this percentage increased enormously in isolated cases, due probably to exceptionally fierce fires. A paper embodying the results of these observations was read at the Punjab Forest Conference in February 1913 in connection with the proposals to introduce the Group System into the Punjab Coniferous forests. A resolution was passed to the effect that departmental firing, combined with concentration of the regeneration areas, might render chir forests safer from fire. Various officers promised to make experiments, including several from the United Provinces.

In April last, advantage was taken in the Rawalpindi Division of various showers of rain to make several experiments in pole and sapling crops. In every case the experiment was successful and the damage done to the chir poles was negligible and almost imperceptible. In every case the fire was started in a continuous line at the top of the hill, and allowed to move in a down hill direction only when the needles and grass were still slightly damp. The experimental areas were small, aggregating in all some 26 acres. They were started in pole crops of eighteen inches and over in girth, and the size of the crop experimented on was successively reduced in succeeding experiments. All the areas had escaped being burnt for at least 15 years and there was generally a thick layer of needles and in some cases moderately long grass. No damage was done in pole or sapling crops, although in places the saplings were only eight to twelve feet in height. In two areas fresh needles fell and a fire was started in

them from below in order to test their safety from an accidental fire. No damage was done in either case, although one of the areas contained a large quantity of dead bushes killed by the previous fire. Some of these areas have been inspected by the Conservator, who has ordered further experiments to be made on a large scale.

These preliminary experiments have undoubtedly been successful and it now remains to confirm their results, and to see if they are applicable to large areas with more limited supervision. The time of year at which the forests can be fired with least harm to the chir will have to be determined. This will probably be in the winter months from December to February. It is not likely that regeneration areas can be fired at all, and it will be necessary to fix a minimum limit below which young chir regeneration must be vigorously protected. Any scheme will involve also the concentration of regeneration areas. This will probably be accomplished in the immediate future as the Working-plan is now under revision.

A subsidiary experiment extending over 40 acres was made at the beginning of July in a forest where fellings had been completed and where the mature trees bore no seed. The whole area was burnt and seed hoed in in lines 2 to 3 feet apart. An early monsoon prevented the soil covering being thoroughly burnt, and partly vitiated the results. The cost of burning, collection of seed, and hoeing in lines amounted to only Re. 1-8 per acre. Where the refuse and grass had been properly burnt the seeds have come up well; but the experiment was otherwise only moderately successful and further experiments are necessary to show if this is likely to prove a cheap and effectual way of restocking blank areas.

It is satisfactory to note that throughout the district right-holders have offered free help to the Forest Department during the coming winter as there is no doubt that burning improves the grass and they are likely to benefit by the proposed measures.

CAMP VIA GHORAGALLI:
1st October 1913.

H. M. GLOVER,
A. C. Forests, Rawalpindi Division.

RECLAMATION OF KOLLURPADU RESERVE.

Kollurpadu is a small village lying within Kandukur Taluk of the Nellore District, Madras, with a population between 2,000 to 5,000 inhabitants and is situated within a mile to the north-west of Ulavapadu station on the East Coast Railway. There is a "Reserved Forest" within the limits of this village, which is named "Kollurpadu Reserve" after the name of the village. The extent included in this Reserved Forest is 574·52 acres as per resurvey.

It is in this reserve that planting operations were started in the year 1903 and these have been continued to the present day. Every year from 10 to 30 acres have been taken up and planted and the area thus treated amounts to 160 acres on the whole. This area forms the subject of the present article.

SITUATION, SOIL, ETC., OF THE LAND.

This reserve is situated about 3 miles to the west of the Bay of Bengal, at about 20 feet above sea-level, between 80° 0′ and 80° 5′ east longitude and between 15° 8′ and 15° 9′ north latitude. It is close by Ulavapadu Railway station on the North-East Railway line which runs through the middle of the reserve, cutting it into two. The Grand Trunk Road from Madras to Bezwada runs parallel to the Railway line and touches the western boundary of the reserve. The plantation is thus easily accessible both by railway and by road. There is also a decent forest rest-house within the limits of the Reserved Forest, with stable and water conveniences.

The ground is almost level with a gentle slope towards the sea. The soil is a reddish loamy sand of varying depth. The average *annual rainfall is about 35 inches, the full benefit of the North-*East monsoon being obtained, while the contribution from the South-West monsoon is relatively small. The level of the underground water is about 20 feet deep and in summer it may be as much as 30 feet.

PAST CONDITION.

When this area was constituted a "Reserved Forest" in the year 1895, it was merely waste land, with patches of prickly-pear

and with a sprinkling of Margosa (*Melia indica*), Jammi (*Prosopis spicigera*) and Palmyra trees coming up in the middle of the prickly-pear bushes. This land was used purely as a grazing ground and very little pasture was available owing to over-grazing. The existence of *Melia indica* and *Prosopis spicigera* was due to the distribution of seeds by crows and that of Palmyra to cowherds who throw away the seeds after eating the edible portion of the fruit. Prickly-pear afforded shelter to the trees during their early growth and afterwards also protected them from the ravages of cattle. Within the area, along the channel, *Acacia arabica* (Babul) was to be seen growing well on both the banks.

METHODS OF WORK ADOPTED.

No. 1 Method.

During the years 1903 and 1904, an area of 40 acres was taken up and planted with broad-leaved species 18 to 24 feet apart. The species used were *Albizzia Lebbek* (Dirasanam), *Pterocarpus santalinus* (Red Sanders), *Chloroxylon Swietenia* (Billu), *Melia indica* (Vepa), *Swietenia Mahagoni* (Mahogany), *Soymida febrifuga* (Sōmi), *Buchanania latifolia* (Sara), *Hardwickia binata* (Yepi), etc. In this area two small plots were planted with *Albizzia Lebbek* pure and the remaining portion with the other species mixed. A few months after, Casuarina was planted between the broad-leaved species, so that it might act as a nurse to the latter. About 400 Casuarina per acre were planted, with an interspace of 12 feet so as to give good shade to the other species.

No. 2 Method.

During the years 1906 and 1907, 50 acres were planted up simultaneously with broad-leaved species and Casuarina nurses, but with the modification noted below. For a group of 9 or 16 broad-leaved plants planted 18 feet apart, 24 or 32 Casuarina plants were put in 9 feet apart surrounding the group, as per illustration given below. The object of this group method is to give more room for the broad-leaved species to develop and to avoid suppression by the Casuarina. In this method the number of plants put

out of broad-leaved species and Casuarina respectively was about the same.

METHOD OF 1906.

C	C	C	C	C	C	C
C	B		B		B	C
C						C
C	B		B		B	C
C						C
C	B		B		B	C
C	C	C	C	C	C	C

No. 3 Method.

During the years 1908 and 1909, 30 acres were taken up and treated under the same method of planting broad-leaved species with Casuarina nurses. Broad-leaved plants and Casuarina were planted alternately, the former at 18 feet and the latter at 9 feet apart. That is, each broad-leaved plant was surrounded by 8 Casuarina plants as shown below. In this method, the number of Casuarina plants was more than double that of the broad-leaved species.

C	B	C	B	C	B	C	B
C	C	C	C	C	C	C	C
C	B	C	B	C	B	C	B
C	C	C	C	C	C	C	C
C	B	C	B	C	B	C	B

No. 4 Method.

During the year 1910, the system was changed from planting to sowing and 10 acres were ploughed and then sown with *Melia indica* (Vepa), *Soymida febrifuga* (Somi), *Bauhinia racemosa* (Ari), *Tamarindus indica* (Tamarind), *Eugenia Jambolana* (Neredu), *Dodonæa viscosa* (Bandaru), and *Cassia auriculata* (Tangedu).

The same system was adopted during 1911 and an area of 20 acres was then sown with *Albizzia Lebbek* (Dirasanam), *Dodonæa viscosa* (Bandaru), *Cassia auriculata* (Tangedu), *Tamarindus indica* (Tamarind), *Melia indica* (Vepa), and *Chloroxylon Swietenia* (Billu).

No. 5 Method.

During the year 1912-1913, an area of 20 acres was ploughed and sown as follows. Furrows were formed and the sowing was done in patches 3 to 4 feet apart and 4 to 6 feet apart. *Albizzia Lebbek* (Dirasanam), *Melia indica* (Vepa), and *Cassia siamea* (Sima Tangedu) seeds were sown in alternate rows, though in patches.

COST OF THE OPERATIONS.

The cost of pitting, planting and watering 40 acres during 1903 and 1904 was Rs. 2,096-14-11.

The cost of pitting, planting and watering 20 acres during 1906 was Rs. 910-12-4.

The cost of pitting, planting and watering 30 acres during 1907 was Rs. 1,134.

The cost of pitting, planting and watering 20 acres during 1908 was Rs. 1,550.

The cost of pitting, planting and watering 10 acres during 1909 was Rs. 900.

The cost of sowing 10 acres in 1910 was Rs. 20.

The cost of sowing 20 acres in 1911 was Rs. 40.

The cost of sowing 20 acres in 1912-13 was Rs. 75-8-3.

The average cost of the planting per acre is therefore Rs. 55 and that of sowing Rs. 2-12-0 per acre.

RESULTS OBTAINED.

In all the planted areas, broad-leaved species are coming up very well and the whole area is now stocked with 100 well established trees per acre. In the plots where *Albizzia Lebbek* was planted pure, it has grown thick and high and the leaf-canopy is complete as the crown has a tendency to spread. The plants have branched at about 4 or 5 feet from the ground thus diminishing the value of the trees. The reason for this is not known but it may have been caused by damage to the leading shoots during early youth,

The results of the sowings may also be said to be successful. In the 1910 area, there is a thick growth of *Melia indica* (Margosa) and *Dodonæa viscosa* (Bandaru), while other species, such as *Eugenia Jambolana, Soymida, Tamarindus indica*, and *Bauhinia racemosa* are also coming up. In this area *Dodonæa* has acted as a nurse. There was such an overcrowded growth of *Dodonæa* and *Melia indica* that the struggle for existence was keen. All the *Dodonæa* was removed and the *Melia indica* thinned out this year, so as to give more room for the better plants to develop.

In half the 1911 area, *i.e.*, 10 acres, the sowing proved unsuccessful and no seeds germinated. In the other half the sowing was also at first thought to have been a failure. All except *Albizzia Lebbek* failed to germinate. In the first year of germination, all the *Albizzia Lebbek* plants were under the grass, in the second year, they successfully resisted the suppression of grass and showed their heads above it. This area is now fully stocked and, in future years, this promises to be a very good forest of pure *Albizzia*.

In the plot of 1912-13, *Albizzia Lebbek* and *Cassia siamea* alone germinated while *Melia indica* failed to germinate. The percentage of germination of *Cassia siamea* and *Albizzia* was 90 and 25 respectively. In groups of 10 or 12 plants, all, except one which was healthy, were removed, so that the plants left would have the full benefit of surface moisture and sufficient room to grow. This operation has done great good to the plants, which have survived the hot dry season and show good height growth.

PLANTING WITH NURSES AND WITHOUT NURSES.

In the area quoted above, all planting was done with Casuarina as nurses. In the early stages of growth Casuarina does afford protection to broad-leaved species from atmospheric influences. In later years, however, Casuarina being a quick grower, outgrows the broad-leaved plants and suppresses them. In the 5th year after planting, Casuarina stands 22 feet high with an average basal diameter of 4 to 5 inches, whereas the broad-leaved species are

then 4 to 7 feet high and about 1 inch in diameter. This suppression is most conspicuous in the plots of 1908 and 1909, where the Casuarina was planted in alternate rows and is not so noticeable in the plots of 1906 and 1907, where the group system has been adopted. The great advantage attained by planting with Casuarina nurses is that the Casuarina tends to make the broad-leaved species grow straight and tapering.

In all the planted areas the Casuarina was retained for 7 or 8 years, until it attained a marketable size, to the detriment of the other species, has been noted above that in the 5th year they were already suppressing the broad-leaved species and the right time for their removal would be the 3rd or 4th year, as was originally proposed, for, by that time, they would have fulfilled the object for which they were originally planted.

No area has as yet been planted in this reserve without nurses so that no results are available for comparison, but I am of opinion that the same results could be obtained without nurses. The only thing required is the selection of those species which are suitable to the locality in the light of the experience which has now been gained in these operations.

SPECIES SUITED TO THE LOCALITY.

The existing growth in the 120 acres planted out in previous years gives an idea of what species are best suited to the soil and locality. *Albizzia Lebbek* and *Melia indica* stand first in rank. These do not die out even when not watered and they stand the hottest weather. *Albizzia*, in its earliest stage, does not grow high but remains 3 or 4 inches above ground; its tap-root however meanwhile develops steadily and the plants thus establish themselves well. In subsequent years it overtops its neighbours and develops a spreading crown. *Melia indica* maintains a steady and uniform development throughout.

The next in rank are the Red Sanders (*Pterocarpus santalinus*), Yepi (*Hardwickia binata*), Somi (*Soymida febrifuga*) and Sara (*Buchanania latifolia*). Though *Pterocarpus santalinus* and *Hardwickia binata* are generally found in hilly tracts, they can also

be grown successfully in this treeless sandy waste. *Soymida febrifuga* and *Buchanania latifolia* are also growing very well and are suited to the soil.

The following figures of girth and height measurements of the above species of different ages are given in support of the above statements :—

Species.	10 years planted in 1903.		9 years planted in 1904.		7 years planted in 1906.		6 years planted in 1907.		5 years planted in 1908.		4 years planted in 1909.	
	G	H	G	H	G	H	G	H	G		G	H
	ft. in.	ft.	ft. in.	ft.	ft. in.	ft.	ft. in.	ft.	ft. in.	.	ft. in.	ft.
Albizzia Lebbek ...	3 6	35	3 3	35	2 9	30	2 8	35	2 0	35	1 4	25
Melia indica ...	1 9	25	2 0	25	1 3	25	1 2	25	0 7	18	0 7	25
Pterocarpus santalinus ...	2 11	40	2 1	32	0 9	20	1 0	25	1 5	35	0 6	20
Hardwickia binata ...	...	...	2 2	30	...	...	...	...	...	...	...	...
Soymida febrifuga ...	2 3	30	2 3	30	1 6	35	1 0	25	...	...	...	...
Buchanania latifolia ...	1 8	30	1 7	30	0 11	20	0 10	20	0 7	20	...	...

The following species have failed more or less completely and do not appear to grow well here :—

(1) *Bassia latifolia* (Ippa), (2) *Chloroxylon Swietenia* (Billu), (3) *Strychnos Nux-Vomica* (Mushti), (4) *Pongamia glabra* (Kanuga), (5) *Tectona grandis* (Teak), (6) *Swietenia Mahagoni* (Mahogany), (7) *Sapindus emarginatus* (Kunkudu) and (8) *Mimusops hexandra* (Pala).

Eugenia Jambolana (Neredu) has done better than the above.

GENERAL.

It is gratifying to see that the sandy waste, which 10 years ago was fully exposed to the scorching sun and to the violence of the wind, which dries up the moisture of the soil, is now covered with vegetation. In the oldest plot planted in 1903 and 1904, advance growth of *Albizzia Lebbek* and *Soymida febrifuga* is noticeable. This goes to show that in future years natural regeneration will be possible.

A Forest Officer will find this interesting area well worth a visit.

KAVILI:
1st October 1913.

C. BALAYYA NAYUDU,
Forest Ranger.

Cabinet Timbers of Australia.—By R. T. Baker, F.L.S., Curator and Economic Botanist of the Technological Museum, Sydney, Australia, published by Government of N. S. W., Government Printing Office, Sydney, 1913.

The primary object of this beautifully illustrated work is to give information to the trade concerning the specific characteristics of representative woods suitable for cabinet work, and without doubt this publication should fulfil the purpose for which it is intended

After a note of introduction by the Minister of Public Instruction, we find a short preface by the author in which he discusses the various classes of possible cabinet timbers found in the great continent of Australia and lays special stress on the value of *Cedrela Toona*, "Red cedar" timber, various *Casuarina* species as substitutes for oak, and *Eucalyptus* species as substitutes for mahogany.

Following the introduction we have a list of timbers described in the body of the work, 64 in all, arranged according to natural orders, scientific and popular names. Then comes a list of the illustrations in natural colours, 68 in all, followed by a list of illustrations in black and white, covering 80 pages. At the end of the book is a note suggesting possible uses of the timbers in connection with cabinet-making; a table of specific gravity; and a summary in tabulated form of weight, facility of working, colour, description of figuring, flower and grain of the species dealt with in the body of the work.

The value of this book without doubt lies in the numerous and beautiful illustrations both of the timbers themselves, which are in colour and of the cabinet work which are photogravures in black and white. The illustrations in colour are amongst some of the best we have seen and reflect great credit on the Government Printers, besides demonstrating the high efficiency to which the art of printing has attained in Australia. We are not in a position to criticise the accuracy of the colouring of these illustrations, since the specimens of Australian timbers available in the wood collections at Dehra Dun have been dulled by exposure. However, amongst other illustrations, is that of *Cedrela Toona*, one of the commonest furniture timbers of Northern India, and if the illustration on Plate X is true to colour for the Australian timber, the Indian Toon is both lighter and pinker in colour. Another timber illustrated on Plate VI, namely, "White Cedar" (*Melia Azedarach*) is found in India and in this instance the plate represents most accurately the timber of this country. The coloured illustrations as a whole demonstrate the great variety of beautiful cabinet woods available in Australia, and though they hardly

come up to some of the Pterocarps and Dalbergias of India as regards variety of colour and beauty of graining, they nevertheless contain some conspicuously beautiful timbers.

The black and white illustrations are well chosen to demonstrate the many and varied styles of cabinet work for which these Australian fancy woods may be utilised. Together with these numerous illustrations are given short notes describing the timbers they represent, to which is added a description of the trees and their distribution. Possibly the value of the work would have been enhanced had a short note been added as to where enquiries should be made for the various timbers, their price and the amount available.

In conclusion we must sincerely congratulate Mr. Baker for having produced a book not only carefully arranged and most beautifully illustrated, but also one which, we think, is well calculated to meet the want for which it has been prepared.

R. S. PEARSON,
Forest Economist.

STERCULIA VILLOSA AND HELICTERES ISORA FIBRES.

[*Extracts from a letter, dated 10th September 1913, from Messrs. Corrie Mackie & Co., Dundee, to the Forest Economist, Dehra Dun.*]

We wrote you on the 13th and 14th ultimo, and are now in receipt of yours of the 15th ultimo.

Sterculia villosa.—We wrote in ours of the 14th ultimo that this had been sampled to a rope-spinner. Since then we have received his report which is not altogether encouraging. The fibre is very hard and consequently difficult to work, and the rope-spinner thinks it will not be of much use unless some chemical process can be found to treat it with, which will soften the small fibres and allow of it being more easily spun. In its present state

there seems to be too much of the natural gum, which binds the small fibres together. We enclose a small piece of the stuff which we think will explain the difficulty better. In parts of the sample the fibre has separated all right, but if you will try and continue the work yourself, you will see that the gum in the broad fibre holds the small fibres together so strongly that they often break off short instead of coming apart. If some chemical could be got to soften this gum and so allow the fibres to separate readily, we think the material would be usable here. At the moment we have another spinner trying the stuff from whom we may hear before the mail goes in which case we will add a line.

Helicteres Isora.—The two sample bundles of this fibre reached us last week. In character it is something like jute. Its chief drawback is want of strength, but several of the spinners tell us that it could be used here by some jute mills. We expect a report shortly from one very large firm, who are testing the fibre for us, and when this comes to hand we shall write you further. We should be glad to know meantime about what price the material would come in at f. o. b. at some seaport. We expect it will be worth somewhere between £15 and £20 per ton delivered in Dundee.

CACTUS FOR COWS.

A LEAD FROM AMERICA.

(From a Correspondent.)

The common prickly-pear has great value as a food for milch cows and oxen, more especially so, in seasons of drought and famine. Its actual feeding value has now been tested for some years on the dairy farm of Wm. Sinclair, Esq., whose ranch lies eight miles east of San Antonio, Texas, U. S. A. The experiments have been conducted on the farm by the U. S. Department of Agriculture, and it is now running on a profitable basis.

The prickly-pear has been used in Texas since its settlement being made use of to carry the cattle through the dry spells, many settlers admitting that it was often the means of saving their stock.

But it is only in the last few years that anyone has thought seriously of cultivating it as a farm crop, or of depending on it as a regular feed all the year round.

Yet this is what is being done at San Antonio, and the writer had the privilege of visiting the farm and can vouch for all the statements here made. It was a novel spectacle. A large herd of cows leisurely grazing in wide fields thickly dotted with prickly-pear and with not a vestige of grass or pasture to be seen. The dry burnt soil, the intensity of the sun's rays, the hot winds, all forcibly remind the visitor of the Indian plains during May and early June, the only difference being that here cattle are seldom found grazing on the cactus which grows so abundantly along the roadsides. There is a good and sufficient reason for this however. All that is necessary is to burn off the spines by means of a gasolene torch when cattle will be found to eat it readily, when once accustomed to it, which does not take long. Fed in this way it becomes one of the cheapest of foods. At San Antonio with a gasolene burner costing $18 (Rs. 54) tucked under his arm and five gallons of gasolene which costs there about 10*c* (5 as.) a gallon, one man in a few hours fed 100 cows all they could eat.

It was an interesting and novel sight as well as a most instructive one to me. The labourers on the farm were for the most part Mexicans, swarthy, tanned picturesque fellows. As I arrived one of them was quickly making his way over a large field, stopping for a few minutes beside each plant of prickly-pear, and playing upon it with the intensely hot blast from the gasolene torch which almost at once singed away the spines, leaving the plant itself practically unsinged. Imagine yourself out in a dry arid field with the cactus plants growing in the baked and parched soil, where rain only falls at long intervals and is usually less than ten inches per annum. We take the gasolene torch, which is a modification of the common torch used by painters or plumbers. About three gallons of gasolene are placed in the reservoir, leaving space for air; air is then pumped in to get a good pressure, a little gasolene is allowed to run out of the coil to heat it and to change

the oil to gas. That gives an intensely hot flame which shrivels the spines almost instantly. The torch in operation made a loud noise, and as the plant was passed by to go on to another, the cattle immediately commenced to munch it contentedly and o enjoy a juicy feed. The plants were growing from four to five feet high and each took but a few minutes to prepare. The cattle certainly seemed to enjoy the food and crowded one another in their eagerness. Those settlers who have no gasolene torch or cannot afford or build a large fire, cut their cactus, place the pieces on a long hay fork, or pointed stick, and hold it over the fire until the spines are singed off. But this old method entails much time and labour, though it might be tried with success in India in years of famines or scarcity of fodder. The cheapest way over the water is found to be to burn off the spines as first described, and let the cows do their own harvesting.

The U. S. Department of Agriculture became interested in the possibilities of the prickly-pear in arid regions some years ago, and after careful investigation decided that there was something in it. They established a number of stations, the first one in San Antonio on Mr. Wm. Sinclair's ranch, followed by others in California, New Mexico, Arizona, Florida and Brownsville, Texas. The conditions at the different stations vary considerably, and those in charge are watching results closely and are doing very valuable work. In 1904 they conducted an experiment on the Sinclair ranch with two milch cows. They were placed in separate pens and were fed on prickly-pear, and the best quality of sorghum fodder, besides the necessary concentrates. Part of the time one cow got nothing but prickly-pear, while the other was fed on sorghum fodder. Then they were gradually shifted until they got half and half. Then the other would get all cactus and so on. The grain feed was constant. Careful weights were kept of feed consumed and milk furnished. The milk was tested for butter fat. At the end of several months it was found that the prickly-pear was the better and cheaper of the two feeds.

The prickly-pear is fed in large quantities. This becomes necessary because of the large amount of water (85 per cent.)

contained in the crop. The cows on the Sinclair ranch ate from 150 to 175lbs. daily.

The advantages claimed by the manager of the ranch for the prickly-pear crop are as follows: it is grown with absolute ease, needing no attention; there is no rush season of planting; if there is any moisture in the soil it will root at any season of the year; there are no expensive buildings to blow down or burn up; it is fed growing in the field; if the settler gets sick and cannot attend to the crop, there is no serious loss; if not needed one year it can be let alone until the next, when there will be three times as much, and it is right there ready to feed any day in the year. A crop of 50 tons per acre per year has been secured. If a cow be allowed 150lbs. of pear daily, that is about 18 tons a year, so it can almost be claimed to furnish roughage for three cows per acre per year. They have proved on their dairy ranch that cows will do very well indeed for more than a year with prickly-pear and grain, and no other form of fodder. It must of course be remembered that if cows are fed pear for long periods of time, some grain has to be fed at the same time to counteract the loosening effects of feeding such a heavy bulk of succulent green food, and large quantities have to be fed in order that the animal may obtain sufficient nutrient materials. But it would seem that it would be eminently suited to feed in famine years in India, even if there was no grain or concentrate available to supplement it with, for the effort would be made simply to carry the stock through the period of scarcity which at the most would not usually last for over a year. Thus large quantities of pear alone could be fed with no other feed, and life be still retained, the animals being subject of course to more or less scours, but this would be far preferable to death from starvation.

The cows on the farm fed on pear and grain, no hay, fodder or other pasture of any sort being added, were in fine condition It was too dry for grass and high temperatures prevailed. The milk found a ready sale at a cent a quart above market rates.

Much has been said and written about spineless cactus. But owing to ravages of rabbits it did not prove a success on the farm

and was soon abandoned for the common variety. The best cactus plants for forage have been found to be the flat-jointed forms, such as *O. Lindheimerii*, which is a native of that section of Texas. The plants are propagated by simply hacking off any portion and sticking it in the ground. If there is moisture it will root.

The precaution must be observed in commencing to feed pear for the first time to hungry cattle, not to allow them all they will eat as bloating is likely to occur, just as it would with any other green food fed in excess.—[*Pioneer.*]

A WOOD THAT NEVER ROTS.

Engineers have often to deplore the rotting of railway sleepers of piles, and of wood used to support galleries, in the building of ships, etc. Engineers, Chemists, Physicists, Biologists, Doctors, who for the construction of diverse apparatus, may require a wood possessing a maximum resistance to the causes of destruction, particularly humidity, are interested in this important question of the unputrescibility of wood. The ideal would be to find a wood of a character susceptible of resisting putrefaction naturally. Now it appears from recent researches that the wood of the mangrove tree may be considered as absolutely unputrescible. Numerous samples of mangrove wood (*Rhizophora racemosa*) sent from French Guinea were, in 1909, placed at Collonges (Cote d'Or) in a soaking pit in the depôt of sleepers of the Paris-Lyons-Mediterranean Railway Company. The samples were surrounded with all the elements susceptible of producing the decomposition and rotting of the wood in a minimum of time. In spite of these precautions the samples have up till now remained in an excellent state, and show no signs of the least alteration. Why is putrefaction unable to attack the wood of the mangrove? From whence do the particular and excellent qualities of this too little known wood proceed? It is first of all to be remarked that the grain of the mangrove wood is very close; for this reason it opposes a barrier to the invasion of water, by a quasi-mechanical action. To get an idea of the importance of this fact, it suffices to examine comparatively the densities of the woods of the mangrove,

oak and fir. The first is about 110, the second 70, and the third 40. Moreover, mangrove wood has an amount of tannin quite sufficient to prevent the invasion of insects and to prevent the multiplication of germs, damp, mould, and all various micro-organisms which constitute the flora of the woods of different climates. The wood of the mangrove marvellously resists flexion, its resistance is double that of oak, quadruple that of fir, nevertheless, it is not at all brittle. To crushing either at the end or across the fibres it offers a resistance double that of oak and three times that of fir. It resists admirably the efforts of wringing or twisting, far better than the two other woods mentioned, to which it is far superior in suppleness. With these qualities just enumerated it is easily worked; it is as easily sawn as the oak. From the few preceding remarks we may conclude that the wood of the mangrove merits employment on a large scale and for purposes both numerous and varied. Henceforth its use appears to be indicated for the construction of the posts of electric lines on account of its unputrescibility, its resistance, and its suppleness. Its resistance to putrefaction and to crushing render it precious for the construction of sleepers of narrow railways. Its use would be advantageous compared with other woods for the special woodwork of mines, where it would offer all the qualities required by hygiene. And, besides everyone will find good use for a wood that never rots.—[*Chemical News and Journal of Physical Science.*]

FOREST FIRES.

NECESSARY FOR CERTAIN TIMBERS.

That forest fires are "part of Nature's programme" in some regions, and are even necessary to the growth of the Southern forests of long-leaf pine, is asserted by Roland M. Harper, of the Alabama Geological Survey, in a "Geographical Report on Forests," published by the Survey (University, Ala., 1913). Dr. Harper's views are quite at variance with current traditions and teachings, "no doubt," he says in a personal letter, "because

most teachers and students of forestry are not familiar with the great Southern long-leaf pine forests, which seem to require occasional fires for their perpetuation." In his report, the writer elaborates this view as follows :—

EFFECT OF FIRES.

"The frequency of fire ...... varies greatly in different kinds of forests, as well as in different regions. In general, the effect of fire in a forest is to keep down underbrush and trees with thin bark or low branches, and thus favour the growth of trees with thick bark and clear trunk, such as most of the pines. It also returns quickly to the soil the potash and other mineral substances accumulated in fallen leaves, but drives off the organic matter, which would otherwise make the soil more nitrogenous. It may also destroy some insects which would otherwise injure the trees.

"Most persons who have written about forest especially in the Northern States where such fires are often much more spectacular and awe-inspiring than they are with us, seem to regard them as an unmitigated evil, or as regrettable accidents, to be prevented by all possible means. In reality, however, fire is a part of Nature's programme in this part of the world, and the woods were undoubtedly set on fire by lightning and perhaps other natural causes long before man appeared on the earth. The frequency of forest fires varies greatly in different regions, and in general they are most frequent to-day in the same regions where they were most frequent in prehistoric times. Fires are and always have been rare in hardwood regions with wet winters and dry summers, like the Tennessee valley and the black belt, where the forest floor is covered with humus, usually too damp and too thoroughly oxidised to burn readily.

IN LONG-LEAF PINE REGION.

"In the long-leaf pine regions, where environmental conditions are different in almost every way from those just mentioned, fire seems to have swept over every spot not protected by its topo-

graphy or otherwise every few years in prehistoric times. There the fire consumes the herbage that covers the ground and prevents the growth of most thin-barked trees, but does very little harm *to the long-leaf pine after that reaches the* age of four or five years. This pine withstands fire better than any other tree we have, but some of the other pines and a few of the oaks and hickories are not much inferior to it in this respect.

"It can be safely asserted that there is not and never has been a long-leaf pine forest in the United States (and that species does not grow anywhere else) which did not show evidences of fire, such as charred bark, near the bases of the trees; and furthermore, that if it were possible to prevent forest fires absolutely the long-leaf pine—our most useful tree—would soon become extinct. For where the herbage has not been burned most of the pine seeds lodge in the grass and fail to germinate, and if the oaks and other hardwoods were allowed to grow densely they would prevent the growth of the pine, which cannot stand much shade, especially when young.

"At the present time most of the fire in the pine woods are set purposely, to burn off the dead grass and improve the grazing. This practice has been repeatedly denounced by persons who have spent most of their lives outside of the long-leaf pine regions, but really the only just criticism of it that can be made is that it is done too often; oftener than Nature intended, one might say. However, as the number of roads, railroads, clearings, etc., increases the area over which each fire can spread becomes more and more restricted, so that the frequency of fire at any one point may not be much greater now than it was originally.

PINE AND OAK WOODS.

"The mixed pine and oak woods which constitute a very large proportion of the forests of Alabama and other southeastern States, occupy an intermediate position between the rich, shady, hardwood forests and the open, long-leaf pine forests with respect to fire. In these woods fire often consumes the dry leaves in late fall, and even though it does little harm to the trees it

tends to impoverish the soil by driving off the nitrogen and other organic matter contained in the leaves, so that it does not seem to be good policy to set fire to such forests purposely, at least where the land is likely to be used for cultivation at some future time."—[*The Statesman.*]

TAUNGYA PLANTATION.

We find an interesting note in the *Indian Forester* on the question of the taungya problem in the Shan States. The writer thinks its abolition by legislation would tend to drive the people out of the country; that it is better to study the system thoroughly and bring it under regulation. Since it is after all wasteful and a real loss to the people themselves, would not a few demonstration farms prove the best means of teaching them more civilised methods of cultivation? Now that these hills are becoming more accessible the method might be tried.—[*Indian Engineering.*]

A NEW NON-PUNCTURING TYRE.

A Home correspondent sends us some details of a new pneumatic tyre which is treated by natural product known as *Cordia Myxa*. This substance is obtained from a species of wild plum which grows in tropical and sub-tropical regions, and is procured by a simple process of sun-drying from the flesh of the fruit For pneumatic purposes a thin layer of this mucilaginous substance is spread on the inside of an inner tube which instead of being made of rubber is constructed of a strong canvas coated with rubber. A tyre so constructed has an inner tube so strong that it will not burst and the layer of *Cordia Myxa*, it is claimed, entirely prevents punctures on account of its sticky and adherent nature. An important feature of the invention is that no valve is required for the purpose of introducing air or gas into the pneumatic tube to which it is applied. Any such tube may be inflated by passing a hollow needle through the fabric. When

the needle is withdrawn the covering material instantly seals and so prevents the escape of the air or gas. From tests made by Faraday House it has been found that *Cordia Myxa* is not affected by frost, and can stand a temperature of over 320 deg. F. Tests have been made running tyres for between 4,000 and 5,000 miles and although many pins and nails were made to pierce the tyre no loss of air took place. The cost of the material is small and tyres can be produced cheaper than the present tyres. A Company has been formed to exploit *Cordia Myxa* commercially called "The Gayner Pneumatic Company, Limited," of Carlton House, Regent Street, and it will not be long before the Gayner tyres are on the market.—[*Pioneer.*]

BANANA JUICE AS A CURE FOR SNAKE-BITE.

A correspondent has forwarded us the accompanying extract from *The Over-Seas Daily Mail*, indicating a remedy for snake-bite which is simplicity itself, and one within the reach of all living and working on our coast lands. Whatever may be the properties of the juice of the stem of the banana plant, it would seem from the newspaper extract that it has something in its composition which destroys the snake-poison. The alleged cures are certified by Mr. W. N. Weston, a resident of Matto Grosso, Brazil, as follows :—

I have witnessed some remarkable cures of bites from poisonous snakes while on a trip in the district of the Rio Taquary. One of these was an Indian peon, who was bitten in the foot by a "Yaraoca" snake. He arrived at the Estancia, apparently in the final stages, bleeding from the gums and all swollen up. A drink of banana juice taken from the *tree trunk* was given him, and in three days he was quite sound.

Another case was that of a child who was treated in the same way and recovered. I also saw the case of a bullock which was snake-bitten and seemed to be dying, unable to get up. We made

an experiment by forcing it to swallow the juice. The swelling subsided, and next day the bullock was almost sound and able to graze.

There is no doubt it is a wonderful remedy, and I would be interested to know if any of your readers have heard of it and could tell me what properties the juice contains.—QUEENSLAND AGRICULTURAL JOURNAL.—[*Tropical Agriculturist.*]

GREEN COLOURATION OF WOOD BY FUNGI.

In Lower Normandy quite three-fourths of the pear trees have their wood coloured green. The author finds that this is due to the presence of a parasitic fungus, *Helotium aeruginascens*, which has previously been found to colour oak and beech wood, and also the wood of *Betula alba* and *B. verrucosa*. Another species of *Helotium*, *H. aeruginosum*, occurs in similar situations and produces the same colour. Such green-coloured woods are often met with in the genera *Fagus*, *Quercus*, *Castanea*, *Betula*, *Alnus*, *Picea*, *Abies*, and other trees. These colouring Discomycetes were classified by Notaris under the name *Chlorosplenium;* but the author shows that this is not a specific genus. The *C. aeruginosum* of Notaris is a *Helotium; C. versiforme* and *C. atrovirens* are *Coryne*, and *C. kriegerianum* is a *Rustraemia*. The two species *Helotium aeruginosum* and *H. aeruginascens* are distinguished by the dimensions of the asci and spores. The appearance of the green colour is not an indication of disease in the trees, but rather of old age. Although it is known in France as "green rot" the term is a misnomer, for the wood is firm and hard and its texture is in no way destroyed or its durability affected. In fact, from its handsome permanent colour, it becomes more valuable for cabinet making and similar purposes. Probably this green pear-wood would be valuable and much appreciated for artistic cabinet work.—P. Vuillemin (*Comptes rend*, 1913, 157, 323).—[*Pharmaceutical Journal.*]

SLEEPERS IN EUROPE.

Our Vienna correspondent writes under date 22nd August as follows :—" A tremendous trade is being done here in railway sleepers drawn mostly from Russia and Poland. Oak sleepers are offered by the million to be delivered at any Black Sea port, on long terms for delivery annually guaranteed by the banks. This may be nothing to India which takes all it can get from Burma. Purchases here are being made for 1914-15-16 even 17, as the prices are as low as 3s. 10*d.* a foot." B. S. Port.—[*Capital.*]

COMPRESSED SAWDUST.

" Our latest invention is compressed sawdust which a Vienna workman, who has patented the process, is fashioning into ornamental furniture. I hear that some English capitalists are greatly interested, for it is anti-white ant and so pliable as to be fitted for the manufacture of sun topees. It threatens to displace cork, and will be a powerful rival even to sola."—[*Capital.*]